

# Compilation of information on alternatives to PFOS, its salts and PFOSF and on sulfluramid

23 February 2018

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# I. Overview of submissions by Parties and observers

## 1. List of submitters

Submitter	Title	Date
<b>Parties</b>		
Brazil	Form	9 Feb 2018
Canada	Form	15 Feb 2018
Canada	Chu et al. 2018	15 Feb 2018
Canada	D'Agostino and Mabury 2018	15 Feb 2018
Canada	Gobelius et al. 2017	15 Feb 2018
Canada	Hermann et al. 2018	15 Feb 2018
Canada	Letcher et al. 2018	15 Feb 2018
Canada	Report on human biomonitoring of environmental chemicals in Canada	15 Feb 2018
European Union	Assessment of the continued need for PFOS, Salts of PFOS and PFOS-F	16 Feb 2018
Germany	Form	16 Feb 2018
Japan	Form	14 Feb 2018
Netherlands	Information-1	12 Jan 2018
Netherlands	Information-2	18 Jan 2018
Netherlands	Information-3	9 March 2018
Poland	Form	16 Feb 2018
United Kingdom	Form	15 Feb 2018
<b>Observers</b>		
Leaf-Cutting Ant Baits Industries Association (ABRAISCA)	Form	15 Feb 2018
Fire Fighting Foam Coalition	Form	15 Feb 2018
FluoroCouncil	Form	14 Feb 2018
Galvano Röhrig GmbH	Form	13 Feb 2018
I&P Europe	Information	15 Feb 2018
International POPs Elimination Network (IPEN)	Information	22 Feb 2018
Pesticide Action Network (PAN)	Form	15 Feb 2018
PAN	Communication	15 Feb 2018
PAN	Photo of atratex label	15 Feb 2018
PAN	Photo of atratex purchased in Curitiba	15 Feb 2018
PAN	Photo of store supplying atratex	15 Feb 2018
Semiconductor Industry Association	Information	15 Feb 2018
Zentralverband Oberflächentechnik (ZVO)	Form	15 Feb 2018

## 2. Information on alternatives to PFOS, its salts and PFOSF

Application	Submitter
<b>Acceptable purposes</b>	
Photo-imaging	Canada, EU, Netherlands, I&P Europe, IPEN
Photo-resist and anti-reflective coatings for semi-conductors	Canada, EU, Netherlands, IPEN, Semiconductor Industry Association
Etching agent for compound semi-conductors and ceramic filters	Canada, EU, Netherlands, IPEN, Semiconductor Industry Association
Aviation hydraulic fluids	Canada, EU, IPEN
Metal plating (hard metal plating) only in closed-loop systems	Canada, EU, Germany, Poland, FluoroCouncil, IPEN, ZVO
Certain medical devices (such as ethylene tetrafluoroethylene copolymer (ETFE) layers and radio-opaque ETFE production, in-vitro diagnostic medical devices, and CCD colour filters)	Canada, EU, IPEN
Fire-fighting foam	Canada, EU, Netherlands, Fire Fighting Foam Coalition, IPEN
Insect baits for control of leaf-cutting ants from <i>Atta spp.</i> and <i>Acromyrmex spp</i>	Brazil, EU, ABRAISCA, IPEN, PAN
<b>Specific exemptions</b>	
Photo masks in the semiconductor and liquid crystal display (LCD) industries	EU
Metal plating (hard metal plating)	EU, FluoroCouncil, ZVO
Metal plating (decorative plating)	EU, FluoroCouncil, Galvano Röhrig GmbH, ZVO
Electric and electronic parts for some colour printers and colour copy machines	EU, I&P Europe
Insecticides for control of red imported fire ants and termites	EU
Chemically driven oil production	EU
Carpets	EU, FluoroCouncil
Leather and apparel	EU, FluoroCouncil
Textiles and upholstery	EU, FluoroCouncil
Paper and packaging	EU, FluoroCouncil
Coatings and coating additives	EU, FluoroCouncil
Rubber and plastics	-

\*The highlighted applications may be assessed in-depth.

## 3. Information on sulfluramid

Submitter
Brazil
Canada
ABRAISCA
PAN

## II. Compilation of information on alternatives to PFOS, its salts and PFOSF

### 1. General

#### 1. Japan

- Not collecting concrete information because what chemicals are used for alternatives is CBI.  
In case of manufacturing new chemicals, however, the new chemicals are controlled appropriately by indispensable evaluation.

#### 2. Canada

- Health/environmental effects including POPs characteristics and other hazards: The following studies pertain to short-chain per- and polyfluoro alkyl substances which are often used as alternatives to PFOS:
  - i. Chu, S.G., J. Wang, G. Leong, L.A. Woodward, R.J. Letcher, Q.X. Li. 2015. Perfluoroalkyl sulfonates and carboxylic acids in liver, muscle and adipose of black-footed albatross (*Phoebastria nigripes*) from Midway Island, North Pacific Ocean. *Chemosphere* 138-60-66. (DOI: 10.1016/j.chemosphere.2015.05.043)
  - ii. D'Agostino L., S.A. Mabury. 2017. Certain perfluoroalkyl and polyfluoroalkyl substances associated with aqueous film forming foam are widespread in Canadian surface water. *Environ.Sci.Technol.* ( DOI : 10.1021/acs.est.7b03994)
  - iii. Gobelius, L., J. Lewis, L. Ahrens. 2017. Plant uptake of per- and polyfluoroalkyl substances at a contaminated fire training facility to evaluate the phytoremediation potential of various plant species. *Environ.Sci.Technol.* ( DOI : 10.1021/acs.est.7b02926)
  - iv. Government of Canada (GOC). 2013. Second Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 2 (2009-2011). <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/environmental-contaminants/second-report-human-biomonitoring-environmental-chemicals-canada-tables-13-1-1-15-12-6.html#tbl-13.8.1>
  - v. Kaboré, H.A., S. V. Duy, G. Munoz, L. Méité, M. Desrosiers, J. Liu, T.K. Sory, S. Sauvé. 2017. Worldwide drinking water occurrence and levels of newly-identified perfluoroalkyl and polyfluoroalkyl substances. *Sci. Total Environ.* 1089-1100:616-617. (DOI: 10.1016/j.scitotenv.2017.10.210)
  - vi. Letcher, R.J., A.D. Morris, M. Dyck, E. Sverko, E. Reiner, D.A.D. Blair, S.G. Chu, L. Shen. 2018. Legacy and new halogenated persistent organic pollutants in polar bears from a contamination hotspot in the Arctic, Hudson Bay Canada. *Sci. Total Environ.* 610-611:121-136. (DOI: 10.1016/j.scitotenv.2017.08.035)

### 2. Photo imaging

#### 1. Canada

- To our knowledge, product changes to remove PFOS and major shifts in the photographic industry led to very low quantities of PFOS still being used in that sector. Globally, it is also expected that the use of PFOS in the photographic sector is declining rapidly as users move towards digital imaging. Several alternatives to PFOS in photography and imaging applications have been identified, and these include digital techniques, telomer-based products of various perfluoroalkyl chain lengths, C3- and C4-perfluorinated compounds, hydrocarbon surfactants and silicone products.

#### 2. Netherlands

- Information on (e) Photo imaging sector: information on paper and printing, and information relevant for developing countries;

- We had a talk with Eddie Michiels (I&P Europe) in January 2018. The information provided indicated that PFOA has in most European applications been replaced. Prohibition of PFOA for these applications will not pose a problem from European perspective. There may be some critical applications in the medical applications, but details were not provided. Analog applications have largely been replaced by digital, but precise percentages are not available. For substitution the first option is to look at non-fluorine substances if applicable. The information below provides some additional information on the I&P sector, Dutch text translated by Google Translate.
- <https://www.milieuinfo.be/dms/d/a/workspace/SpacesStore/706b0fc2-ca0f-4c9d-9367-5c8306a0a420/MLAV1-2014-0314.pdf>

Province of Antwerp, 2014, MLAV1-2014-0314 / NIVD / woha: DECISION OF THE DEPUTATION OF THE PROVINCE OF ANTWERP ABOUT THE LICENSE REQUEST BY NV AGFA-GEVAERT WITH REGARD TO A CHEMICAL COMPANY, LOCATED IN 2260 WESTERLO, AUGUST CANNAERTSSTRAAT 125.

- The company has through process optimizations, synthesis adjustments and investments end-of-pipe techniques can reduce the discharge of hazardous substances. There are including the following measures:
  - Restriction on the use of halogenated solvents;
  - Minimization of the use of NaOCl;
  - Ban on the use of perfluorinated compounds (PFOS, PFOA);
  - Ban on the use of phenols and limitation of MAK (toluene, xylene, ...);
  - Collection of silver-containing process waste water;
- Also at the request of AMI, in addition to a discharge standard for PFOA, a discharge standard is also requested for PFOS and PFHxS. Agfa-Gevaert requires the following standards: 0.570 mg / l for PFOA, 0.025 mg / l for PFOS and 0.001 mg / l for PFHxS. The proposed standards were discussed with the environmental coordinator in a consultation with VMM and AMV on 11 March 2015.
- Although PFOS and PFOA have not been used or produced for more than 5 years and the sedimentation basin for the waste water and the process sewers have been completely cleaned in the meantime, very minute quantities of these substances are still being measured in the wastewater. The operator has agreed in the consultation with the following standards that are stricter than initially requested: 3 µg / l for PFOA, 1 µg /
- DECISION OF THE DEPUTATION OF THE PROVINCE OF ANTWERP ABOUT THE LICENSE REQUEST BY AGFA-GEVAERT AGREEMENT WITH REGARD TO AN ESTABLISHMENT FOR THE MANUFACTURE OF PHOTOGRAPHIC PRODUCTS, LOCATED AT 2000 ANTWERP - 2640 MORTSEL, SEPTESTAAT 27, AND ABOUT THE NOTIFICATION OF THE THIRD-CLASS ESTABLISHMENTS.
  - PFOA AND PFOS: these products are used in the photographic sector because of their unique physical and photographic properties. PFOS is no longer used today.
  - Use of it is completely prohibited within Agfa and the remaining stock was completely destroyed.
  - A replacement program was set for PFOA. The products concerned (Amfluk and Kapri) were replaced where possible by a combination of non-fluorinated products humidifiers and / or 2 better degradable fluorinated compounds with no PFOA arises. Both the medical and graphical range is, with the exception of a few niche products, almost completely switched over. NDT products will be available at the end of 2009 are switched. Cinematographic film will be switched in 2010.
  - The result is that:

- The PFOS concentrations in the waste water are all below the proposed target value of <0.03 mg / l.
  - The PFOA concentrations are below the new PNEC value from the current "European Exposure Assessment and Risk Characterization" of 0.570 mg / l for aquatic organisms. The target value set in the environmental permit of 06/03/2008 (MLWV / 07-50) was proposed was 0.220 mg / l, the operator requires a standard of 0.570 mg / l.
  - PFOA will also be discharged when the WZI (waste water treatment plant) is in operation. As already above stated there was an ecotoxicity study. The result was that the waste water was 'little acutely toxic' with an effect unit of 1.2 to 1.8 on a scale of 0 to 100. The prescribed chronic rotational test showed no reproduction inhibition or, therefore, chronic toxicity. gone with a standard of 0.570 mg / l.
3. I&P Europe (including Electric and electronic parts for some colour printers and colour copy machines)
- Despite the fact that PFOS, its salts and PFOSF are listed in Annex B to the Convention with photo imaging specified as an acceptable purpose, member companies of I&P Europe Imaging & Printing Association have pursued further elimination of PFOS where possible, thereby demonstrating their commitment to act as a responsible industry.

Results of a recent internal inquiry of I&P Europe, conducted in November and December of 2017, indicate that PFOS is forecasted to be completely phased out in 2018 or 2019 at the latest – i.e. that as of then PFOS is foreseen to be no longer used by its member companies.

The forecasted complete elimination of PFOS in photo imaging products manufactured by member companies of I&P Europe will predominantly be a result of the combined effects of a continued technology shift towards digital techniques replacing conventional photographic coatings and a continued search for alternatives in the few remaining conventional photo-graphic materials that still required PFOS.

Substances to be used in photographic coatings require properties inherent to the manufacture of imaging materials, e.g. lack photoactivity and thus do not interfere with the imaging process, do not interfere with a number of other intrinsic properties of conventional photographic coating solutions such as colloidal stability. As a consequence, some known possible alternatives for PFOS that have been identified in other areas – such as silicone products and siloxane com-pounds – are hence in practice not usable as alternatives in the manufacture of conventional photographic products.

The search towards alternatives for perfluorinated C8 substances or fluor telomer based C8 substances typically involved a “preferred replacement hierarchy” favouring non-fluorinated hydrocarbon alternatives, followed by non-perfluorinated substances, further followed by per-fluorinated substances with short chain lengths (C3 or C4).

PFOS (and PFOA) substances are “unique” in that they combine a number of properties re-quired in state of the art photographic coatings into one molecule. Sustained research resulted for some remaining applications in finding combinations of two or more hydrocarbon sub-stances demonstrating a super-additive effect that resulted in performance characteristics comparable to PFOS (or PFOA).

It should be noted that these findings resulted from sustained elaborate and often product specific research the results of which are clearly in the domain of confidential business infor-mation.

Also specific information regarding substitution products for PFOS outside the preferred cate-gory of non-fluorinated hydrocarbon alternatives is considered to be confidential and is not shared between member companies of I&P Europe.

Continued commitment of member companies of I&P Europe Imaging & Printing Association resulted in a forecasted complete elimination of PFOS by 2018 or 2019 at the latest in photo imaging products manufactured by member companies of I&P Europe.

This achievement will predominantly be a result of the combined effects of a continued technology shift towards digital techniques and a sustained search for alternatives in the few remaining conventional photographic materials that still required PFOS.

Research for alternatives typically involved a preferred replacement strategy favouring non-fluorinated hydrocarbon alternatives.

However concrete detailed information on alternatives for PFOS identified and used in imaging products cannot be provided because it is considered confidential business information.

#### 4. EU

- PFOS and PFOS-related substances have been used in this industry for photographic films, film paper and reprographic plates for industrial use. According to Table 5 alternative substances and alternative techniques are available and in place (that is also indicated by decreased usage of these substances in EU Member States (ESWI 2011)). However Japan reported manufacture of photographic film for industrial use is allowed as exceptions because no alternatives exist (Japan, 2016). Also for Canada the manufacture, use, sale, offer for sale and import of photographic films, papers and printing plates is permitted (Canada, 2013). Ongoing production and/or use for this AP occurs also in Turkey, China and Vietnam.

#### 5. IPEN

- This is an obsolete use of PFOS since it has essentially been replaced by digital imaging – even in developing country uses such as healthcare. As noted by the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO), medical diagnostic imaging began in the 1970s and the momentum has grown to the extent that “digital image management is currently the preferred method for medical imaging.” IAEA and WHO note that the rapid adoption of digital technology in healthcare results from “efficiencies inherent in digital capture, storage and display and the competitive cost structures of such systems when compared to alternatives involving film.” Some drawbacks of film-based imaging include use of chemicals that require careful handling, certain storage and use conditions, and environmentally sound waste management. Advantages of digital imaging in healthcare noted by IAEA and WHO include:
  - i. Efficient information dissemination and increased access to images.
  - ii. Significantly better dynamic range of digital image acquisition systems.
  - iii. Improved reliability, error free retrieval of images without loss.
  - iv. Ease of use.
  - v. Potential for multimodality, composite imaging.
  - vi. Retention of dynamic diagnostic information.
  - vii. Simultaneous transmission and display of images to multiple geographical areas.
  - viii. Image manipulation and processing, feature extraction and enhancement.
  - ix. Ease of interaction between specialists, e.g. between radiologists and referring physicians.
  - x. Expertise in subspecialties of diagnostic imaging can be widely disseminated.
  - xi. Studies are available to authorized viewers immediately after image acquisition.
  - xii. Examination sequencing and tailoring and the integration of diagnostic data are possible.
  - xiii. Elimination of environmental problems caused by film based imaging.

While established companies making film products claim that price points dictate the ability of developing countries to use digital technologies, in practice developing countries are leapfrogging over the film stage and rapidly adopting digital technology. In fact, some physicians note that instead of viewing digital technology as too high-tech for developing country settings, digital

imaging in particular allows for transfer over long distances thus permitting advice and diagnosis that otherwise would not be available.

Technology-based mobile health is rapidly increasing in developing countries. For example, the entire healthcare system in Gabon is rapidly becoming digital. Furthermore, alternatives to instruments using film are being rapidly adopted. For example, 3D digital mammography systems are already available across South Africa. In Bolivia, digital photos are used as an appropriate tool for dietary assessment. In rural Kenya, mobile digital x-ray equipment serves patients that cannot travel to Nairobi for this service and the images are uploaded into the patient's electronic medical record. In Latin America, the market for digital dental x-rays is projected to increase from USD\$100 million in 2016 to USD\$149 million by 2021. Kazakhstan began moving to install digital radiography devices for national breast cancer screening in all public hospitals in the country in 2013. Advanced telemedicine with the use of digital imaging has become a standard practice for healthcare in remote Arctic Indigenous communities, giving healthcare providers the ability to "share images and consult with specialists in real-time...In the past, film images had to be shipped hundreds of miles to the hospital. Now they're forwarded from the workstation to a server, transmitted via satellite or microwave and read by clinicians in the territorial capital within 10-15 minutes." The PFOA Risk Management Evaluation notes that, "Digital imaging will replace the need for PFOA in photo-imaging and the transition is occurring rapidly." This is also true for PFOS. In IPEN's view, there is no justification for continuing this archaic use of PFOS when it has already been replaced by digital technologies.

The POPRC should recommend ending the acceptable purpose for PFOS use in photo imaging.

### **3. Semi-conductors (Photo resist and anti-reflective coatings for semi-conductors; etching agent for compound semi-conductors and ceramic filters)**

#### **1. Canada**

- Historically PFOS has been one of the main PFAS used in top anti-reflective coatings. In May 2017, the World Semiconductor Council indicated that their membership had completely phased out PFOS. It is expected that the majority of the sector worldwide has ceased using PFOS.

#### **2. EU**

- **Photo resist and anti-reflective coatings for semi-conductors:** Fluorinated surfactants and fluorinated polymers are used in the semiconductor industry. While in non-critical uses (e.g. developing agents) substitution of PFOS and PFOS-related substances has already taken place (e.g. by PFBS (perfluorobutanesulfonic acid), perfluoropolyethers or telomers according to KEMI, 2015) for photo-resist and anti-reflective coatings for semi-conductors alternative formulations are only recently available on the market (cf. Table 6). For reasons of business confidentiality, information on the alternate chemistry used is inconsistent. Industry, together with suppliers have been working on PFOS-free solutions, however more time is needed according to industry to evaluate whether the existing critical use exemptions should continue (cf. UNEP/POPS/COP.7/8 and UNEP/POPS/COP.7/INF/11). In Canada the manufacture, use, sale, offer for sale and import of photo - resists or anti - reflective coatings for photolithography processes is allowed (Canada, 2016). For PFOS or its salts, they are still approved for the uses including the photosensitive film of semiconductors in Japan (Japan, 2016). Also, Turkey, China and Vietnam registered production and/or use for this AP.
- **Etching agent for compound semi-conductor and ceramic filters:** PFOS has been used in the etching processes for compound semiconductors and piezoelectric ceramic filters. Ongoing production and ongoing use is reported for China, EU, Japan, Vietnam. While also Turkey, Canada, Norway and Switzerland are registered for ongoing use Canada did not allow this use according to the NIP (Canada, 2013). In contrast to the submission from IPEN that pointed to new information on alternatives from Japan, the Japanese NIP dated 2016 clearly approves the use including the manufacture of the etching agent for the piezoelectric ceramic filter or composite semiconductor for high frequency bands (Japan, 2016). This is also contradictory to the information given by the BAT/BEP task team (2016) that quoted another information source from

Japan that the use has been eliminated. However, from the presented information in Table 7 it can be concluded that industry has successfully eliminated or is taking steps to terminate PFOS use for this AP. Alternative fluorinated substances are available and in commerce.

### 3. Netherlands

- From NXP Semiconductors we received the following information in August 2017 on our request concerning PFOS:
  - Of the five so-called acceptable purposes for PFOS, only the 'photo-resist and anti-reflective coatings for semi-conductors' were (or were) directly relevant to NXP. We have implemented a phase-out policy in recent years, which has resulted in PFOS being free. That means that we no longer need the exception position here. We do not recognize the use of PFOS as 'etching agent for compound semiconductors' for NXP.
  - In general, these fluorine-containing compounds are added in small amounts to, for example, photoresists or coatings in order to influence the surface properties in a good way. It has been found over the years that without these fluorinated compounds the required properties cannot be obtained. Since the quantities are small and often a trade secret, the suppliers are not always willing to provide clarity about the precise connections. That is why we are not currently aware of the chosen replacement products of PFOS, but we do not think that this fluorine will be free. Nevertheless, as NXP we try to keep in touch with our suppliers about upcoming legal changes such as those appointed for e.g. PFOA and PFHxS, which are already under REACH. It is in fact in no one's interest, given the length of qualification of new materials, to end up in a constant state of change, the outcome of which can be rather uncertain. On the other hand, our suppliers will need some fluorinated compounds to provide us with materials with the right properties (with the application: 'photo-resist and anti-reflective coatings for semi-conductors'). The future will show whether and how these characteristics can be reconciled with the attention to perfluoro compounds, but it is clearly an area in which we see changes coming up in the coming years and any information on this as you are mentioned below is welcome. In view of the long replacement routes (several years), we expect to find another position in the future that requires an exceptional position for shorter or longer periods.
- Mail from Peter Schat, NXP Nijmegen, The Netherlands, 17 January 2018: **Subject: PFOA in semiconductor industry**
  - As far as the use of fluorinated compounds in general in our production processes is concerned, for the application 'photo-resist and anti-reflective coatings for semi-conductors' the mail from August 2017 gives the correct representation: fluorine compounds will be used in these applications, but the substances that are concerned are generally trade secrets.
  - As far as PFOA and PFHxS are concerned, it can be reported that PFOA has not been used by NXP in production processes for a long time and PFHxS indicates that our suppliers of photoresists and anti-reflective coatings do not present it in their formulations. We cannot, of course, make any statements for other semiconductor companies. There may be applications where PFOA or PFHxS are still in use and for which alternatives are not immediately available.
  - However, where we are very concerned in the formulation of the PFOA exemption proposals, parts (a) (i) a and b and part (b) of the proposal are: an exception for limited time for PFOA as a residue in fluoropolymers and fluoroelastomers such as present in (legacy) equipment and (legacy) production facility related infrastructure.
  - The impact on infrastructure is expected to be much greater than the phasing out of PFOS from our production processes in recent years. To produce a mere inventory of infrastructure and parts of production equipment containing fluoropolymers and fluoroelastomers is an almost impossible task given the complexity of a semiconductor plant and the number of suppliers of equipment, parts and materials for infrastructure involved. In addition, it is technically very challenging to check whether there is a presence of PFOA residues.

Whereupon suitable replacement materials and components must be found for the various applications, where there is equipment, parts and infrastructure with PFOA residues.

- In contrast to production processes, no high-level PFOS / PFOA emissions from the existing infrastructure is expected. Implementing the same measures for both production processes and infrastructure, however, has an excessive impact on business operations as described above. Therefore, the exemption position for PFOS / PFOA production processes for NXP is not necessary, but if the infrastructure is involved, this exempt position is indeed important and should, in our opinion, be permanent.

#### 4. IPEN

- **Photo resist and anti-reflective coatings for semiconductors:** Parties registered for this use are: Canada, China, Czech Republic, EU, Japan, Norway, Switzerland, Turkey, and Vietnam. However, Vietnam notes that they are conducting an inventory of PFOS use and they may be able to withdraw acceptable purposes for this use based on their outcomes.

PFOS serves a surface tension and reflectivity reduction function in the photo-resist process of semi-conductor manufacturing. The POPRC Guidance document indicates that cost should not be barrier in developing alternatives to PFOS in this process: “The cost of developing a new photo-resist system is estimated to be US\$700 million (0.3 % of annual sales) for an industry which had global sales of US\$248 billion in 2006. This indicates that cost is not a barrier to develop a new photo-resist system.” The scientific literature indicates that it should be possible to develop a PFOS-free photo-resist system. The patent literature also indicates active work in this area. For example, patents describe fluorine-free photoresist compositions as an alternative to PFOS/PFAS use. Fuji describes photo-resists that are “PFOS & PFAS free”. The POPRC PFOS alternatives guidance notes that patents are being approved for fluorine-free alternatives to PFOS use in photoresist. There are currently photoresist systems made by Rohm and Haas and Dow Chemical that are PFOS/PFOA-free. IBM began PFOS/PFOA phase-out in 2003 and eliminated PFOS and PFOA in its wet etch processes in 2008, and in all of its photolithography processes in 2010.

The World Semiconductor Council meets annually at the CEO level in May. On 18 May 2017, the World Semiconductor Council (WSC) made the following announcement: “The WSC is pleased to announce today that the companies participating in the WSC have successfully eliminated the remaining critical uses of (perfluorooctyl sulfonate) (PFOS) in semiconductor manufacturing processes. This elimination is a major environmental management achievement for the worldwide semiconductor industry that has been working on managing and substituting PFOS.” In making the announcement, the industry association recommended notifying ministries of environment and the Stockholm Convention of this PFOS phase-out. The World Semiconductor Council has association members of companies located in many countries including the top four global semiconductor manufacturers : Intel, Samsung, TSMC, and Qualcomm.

Considering the presence of technically feasible alternatives and their commercial adoption, the POPRC should recommend ending this acceptable purpose.

- **Etching agent for compound semiconductors and ceramic filters:** Parties registered for this use are: Canada, China, EU, Japan, Norway, Switzerland, Turkey, and Vietnam. Vietnam notes that they are conducting an inventory of PFOS use and they may be able to withdraw acceptable purposes for this use based on their outcomes.

PFOS serves a surface tension and reflectivity reduction function in etching processes in the semiconductor industry. According to a submission from Japan, alternative methods that could eliminate PFOS for this use were expected in 2014. The Committee and/or Secretariat should follow up with Japan to get information on these alternatives for use in the POPRC Guidance and its subsequent recommendations.

As an example of the proliferation of technically feasible alternatives, IBM began PFOS/PFOA phase-out in 2003 and eliminated PFOS and PFOA in its wet etch processes in 2008. The company went on to eliminate PFOS/PFA in all of its photolithography processes in 2010. The

process changes also reduced consumption of other chemicals and the company claims that chemical use was reduced by 18 million pounds per year (8.2 million kg/yr) in 2007 – 2009 but accompanied by at 5% increase in production. Taiwan Semiconductor (ranked #3 semiconductor manufacturer in the world with sales of USD\$29.3 billion in 2017 ) eliminated PFOS from its manufacturing process in 2010.

Alternative methods using dry etching are technically feasible, commercially used, and now actually bigger than wet etch processes using chemicals. This includes the plasma etching process. Plasma etching is currently used commercially using low-pressure plasma systems. Wet-etching using PFOS can result in high throughput and selectivity, but it uses large quantities of chemicals causing high costs for both use and disposal along with other disadvantages such as photoresist adhesion problems and difficulties with small geometries.

Plasma etching does not cause photoresist adhesion problems; uses small amounts of chemicals; lowers cost of disposal of reaction products; and can be used in automated processes. Its disadvantages include use of complex materials and the possibility of poor selectivity and residues left on the wafer. However, according to plasma etching system manufacturers, controlled plasma etching removes all unwanted organic residues from the metal surface unlike acid etchants; sticks two surfaces better than acid etchants; improves the physical properties of the etched material; and is less risky and less costly.

A new dry etch technology now being commercially introduced is atomic layer etch (ALE), which selectively removes materials at the atomic scale. These can be plasma or thermal based systems or a hybrid of both. Suppliers of these technologies include Applied Materials, Hitachi High-Technologies, Lam Research, and TEL. The ALE market is currently USD\$50 - \$100 million/yr business and expected to grow to USD\$450 million by 2020. Both Samsung and LG are moving to atomic layer techniques for manufacture of OLED displays for smartphones and TVs.

The World Semiconductor Council meets annually at the CEO level in May. On 18 May 2017, In Kyoto, Japan, the World Semiconductor Council (WSC) made the following announcement: “The WSC is pleased to announce today that the companies participating in the WSC have successfully eliminated the remaining critical uses of (perfluorooctyl sulfonate) (PFOS) in semiconductor manufacturing processes. This elimination is a major environmental management achievement for the worldwide semiconductor industry that has been working on managing and substituting PFOS.” In making the announcement, the industry association recommended notifying ministries of environment and the Stockholm Convention of this PFOS phase-out. The World Semiconductor Council has association members of companies located in many countries including the top four global semiconductor manufacturers : Intel, Samsung, TSMC, and Qualcomm.

Considering the presence of technically feasible alternatives in wide commercial use, the POPRC should recommend ending this acceptable purpose.

#### 5. Semiconductor Industry Association

- The associations of the global semiconductor industry appreciate the outreach from the Secretariat on behalf of the POPs Review Committee (POP-RC) of the Stockholm Convention for information on the continued need for specific exemptions and acceptable purposes for the use and production of perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF) as listed in Annex B to the Convention.

The associations are pleased to report that the semiconductor industry globally has successfully completed the phase-out of PFOS, and therefore the industry no longer have a need for use exemptions in our industry. A global industry entity, the World Semiconductor Council (WSC), announced last year that the industry completed the phase-out of PFOS (see pp. 6-7, and Annex 1 on pp. 24-26). The industry’s ability to eliminate the use of PFOS was the result of a concerted effort by semiconductor companies over many years and required a significant investment of resources and technical expertise to identify, qualify, and integrate alternative chemicals that met our demanding performance requirements. We appreciate the POP-RC for working with the industry to provide appropriate exemptions over time that enabled the industry to achieve this

result in an orderly fashion. This result demonstrates that the global semiconductor industry and the POP-RC, working in a coordinated manner, can achieve shared environmental goals.

As the POP-RC continues its work on other chemicals of potential interest to the semiconductor industry, including the ongoing work on PFOA and related substances, we are hopeful the POP-RC and the semiconductor industry are able to work together again in a similar fashion to achieve environmentally beneficial results in a manner consistent with our technological and business needs.

As we have informed the Secretariat and the POP-RC previously, the semiconductor industry relies on chemicals (such as perfluorinated chemicals) that possess specific chemical and physical properties and functional attributes required to manufacture advanced semiconductor devices. There currently are no known alternatives to many of these chemicals for use in our manufacturing processes. To the extent that specific chemicals are determined to pose potential environmental or health risks, the industry has a demonstrated record of achievement in working to reduce use of these chemicals, minimize emissions, and identify and implement substitutes when possible. We will continue this work in the future. When considering taking action on future chemicals that may be critical to the semiconductor industry we recommend the POP-RC to take into account a variety of factors in their reviews of chemicals, such as criticality of specific chemicals, the availability of proven substitutes, the time needed to qualify and transition to substitute chemicals if available, the limited potential risk of exposure to workers, the small quantity of chemicals used in manufacturing processes or contained in articles, and the fact that these chemicals are not intended to be released from the finished product under normal conditions of use.

We further suggest that if taking action in the future on chemicals of concern, the POP-RC continue to work cooperatively with the semiconductor industry to ensure use exemptions are established and remain in place to provide the time necessary for the industry to identify and qualify alternatives and integrate these new replacement chemicals in our manufacturing processes. Adopting this approach will enable the industry to identify whether and when specific chemicals can be replaced and if so, eliminate the use of substances of concern in an orderly manner while continuing to innovate in semiconductor technology.

#### **4. Aviation hydraulic fluids**

1. Canada

- Information gathered through consultation indicated that no PFOS is intentionally added to aviation hydraulic fluids.

2. EU

- Several countries including China, Vietnam, Canada, the EU, Norway, Switzerland, Turkey and Zambia registered for ongoing use for PFOS (for production China, EU and Vietnam only). Fluorinated phosphate esters (that may contain other fluorinated additives) are used alternatives but no detailed information concerning their performance, chemical composition of the aviation hydraulic oils or environmental and health impacts is available. The hydraulic fluids existed before PFOS was industrially available and the oil based fluids might be an alternative (UNEP/POPS/COP.7/8). Overall the knowledge about used alternatives is very limited for this AP.

3. IPEN

- The POPRC considers this use to be an open application use of PFOS, indicating that it should be prioritized for phase-out. Parties registered for this use are: Canada, China, Czech Republic, Turkey, Vietnam and Zambia. Both the EU and Norway have withdrawn their acceptable purposes for this use, indicating the availability of feasible alternatives. Both Vietnam and Zambia note that they are conducting an inventory of PFOS use and they may be able to withdraw acceptable purposes for this use based on their outcomes.

In 2012, the POPRC requested Parties and Observers to provide information on whether PFOS was even still used in aviation hydraulic fluids. The request came from a Committee

investigation of alternatives to the use of PFOS in open applications which noted that there are a large number of products (Arnica, Tellus, Durad, Fyrquel, Houghto-Safe, Hydraunycoil, Lubritherm Enviro-Safe, Pydraul, Quintolubric, Reofos, Reolube, Valvoline Ultramax, Exxon HyJet, and Skydrol) but very little information about what they actually contain. A review of the brands listed indicates that the Lubritherm Enviro-Safe claims to be “fully biodegradable”. Since PFOS is not biodegradable, the company should be asked if that means it does not contain the substance. Other major manufacturers such as Eastman (Skydrol), Exxon (HyJet), and Valvoline should be questioned directly about whether PFOS has been eliminated in their products.

The updated POPRC PFOS alternatives guidance notes the use of fire-resistant aviation hydraulic fluids principally containing tri-alkyl phosphates, tri-aryl phosphates, and mixtures of alkyl-aryl-phosphates. The guidance also notes that Spain and Norway use fluorinated phosphate esters as alternatives to PFOS in aviation hydraulic fluids.

Considering that this is an open application of PFOS and the presence of technically feasible alternatives, the POPRC should recommend converting this acceptable purpose to a specific exemption so that a time limit for phase-out of this use can be established.

## 5. Metal plating

### 1. EU

- The EU proposes in its Council Decision (EU) 2015/627 of 20 April 2015 the deletion of the specific exemptions for PFOS in metal plating (hard metal plating and decorative metal plating), with the exception of hard metal plating only in closed-loop systems, listed as an ‘acceptable purpose’ in the Convention.

### 5-1. Metal plating (hard metal plating) only in closed-loop systems

#### 2. Canada

- This use was prohibited in Canada in 2008.

#### 3. EU

- Some countries including Norway or Germany and other information sources indicate that fluorinated and non-fluorinated alternative substances and technologies are available and substitution is underway. Some alternatives have been tested but have been found to be less efficient and not all processes are suitable for the use of PFOS-free mist suppressants/wetting agents. Besides China, Vietnam, Turkey, Norway and Switzerland several EU member states indicated continuous need for this AP. Canada and Japan discontinued this use according to their NIPs (Canada, 2016; Japan, 2016). Brazil mentioned in its NIP dated 2015 that the reduction of PFOS in the metal plating sector has high priority (Brazil, 2015).
- Detailed discussions on “Closed loop” allowed as acceptable purpose vs hard metal plating and decorative plating allowed as specific exemptions.

#### 4. Germany

- In order to gain a better understanding in which cases PFOS is needed in hard metal plating, and where it can be substituted, or the process changed to make the use of PFOS obsolete, Germany has funded a study which has been communicated to the BRS secretariat earlier, and is published here: Blepp, Willand, Weber (2017): Use of PFOS in chromium plating – Characterisation of closed-loop systems, use of alternative substances, German Environment Agency (<https://www.umweltbundesamt.de/publikationen/use-of-pfos-in-chromium-plating-characterisation-of> )
- In the case of metal plating, as in many other cases, there is no single answer to substitution of PFOS.
- The alternative to PFOS used most frequently at present consists in the partially fluorinated substance H4PFOS12 CAS-No.: 276-19-97-2 (C8F13H4SO3-), also referred to as 6:2

fluorotelomer sulfonate (6:2 FTS) or 1H,1H,2H,2H-perfluorooctane sulfonic acid. By further transformation in the environment, this telomere-based alternative can degrade to become the stable perfluorohexanoic acid (PFHxA) and can be detected in water bodies.

- As a rule, the surfactants are placed on the market in the form of mixtures rather than pure substances. Such mixtures are produced either by the manufacturer of the substance himself or a formulator. In the electroplating sector, many mixtures are not purchased directly by the electroplating company. Their use in the electroplating company is serviced by a specialized company. As a rule, the formulators will closely cooperate with these specialized companies (Blepp et al. 2013).
- The following alternatives to PFOS are being discussed and/or used:
  - i. Fluorinated substitutes: As to their uses, these substances are comparable with PFOS, and they can be used in almost all processes including chromo-sulfuric acid etchant, bright chromium and hard chromium electrolytes. The fluorinated substitutes can be divided into three sub-groups:
    1. short-chain fluorinated surfactants;
    2. polyfluorinated surfactants; and
    3. polyfluorinated compounds.
  - ii. Fluorine-free substances: These have already been partially used in bright chrome electrolytes. According to some suppliers of process chemicals, their use in hard chromium electrolytes is also possible. According to the current state of knowledge, the use of such substances should be considered on a case-by-case basis.
- Also alternative technologies, such as PTFE-coated balls on top of bath are mentioned, among other options. However, in this respect, the state of knowledge is that this alternative will not reduce chromium emission from the chroming bath but, in contrast, chromium emissions appear to increase, as compared to emissions released in cases where no mist suppression is applied at all. Another physical alternative, namely in the form of a mesh or a blanket (<http://www.subsport.eu/case-stories/179-de/?lang=de>), could be considered for large-scale series plating of uniform products. However, this kind of alternative will still require considerable research.
- No surfactants are required e.g. in processes where surfaces are coated in a closed coating reactor. This is a technical solution in the field of hard chrome plating where neither any rinse water nor gas emissions will lead to environmental pollution by PFOS ([http://www.topocrom.com/content/pdf/Artikel\\_Verfahren\\_k\\_muell.pdf](http://www.topocrom.com/content/pdf/Artikel_Verfahren_k_muell.pdf))

#### 5. Poland

- 2-(Perfluorohexyl)ethane-1-sulfonic Acid; CAS: 27619-97-2 (6:2 Fluorotelomer sulfonate) in product: SLOTOCHROM CR 1271 (Schlötter Galvanotechnik) Alternative for PFOS and PFOS derivatives. The alternative mentioned is available on the market.
- Product: TIB Suract CR-H; Alternative for PFOS and PFOS derivatives. The alternative mentioned is available on the market.
- The above information was gathered from product suppliers' responses on a survey conducted in 2018.

#### 6. FluoroCouncil (including information on Metal plating (hard metal plating) and Metal plating (decorative plating) as specific exemption)

- Short-chain fluorotelomer-based and electrochemical fluorination (ECF)- based fluorosurfactants.
- Widely purchased and commercially available at global level. For example, short-chain fluorosurfactant alternatives such as 6:2 fluorotelomer sulfonate (CAS# 425670-75-3) and potassium perfluorobutane sulfonate (CAS# 29420-49-3) have been reviewed and approved by

multiple competent regulatory authorities worldwide. These substances are commercially available from numerous suppliers globally.

- The technical feasibility of the alternatives is specific to the industrial metal plating process in practice. Users have adopted alternatives that meet their industrial use requirements. No one substance has provided a universal solution as a replacement for PFOS.
- Yes, available globally and approved by regulators. Short-chain alternatives have been adequately reviewed and approved by multiple competent regulatory authorities worldwide.
- References containing hazard information.
  - i. 6:2 Fluorotelomer Sulfonate
    1. Toxicology Data for Alternative "Short-Chain" Fluorinated Substances. In Toxicological Effects of Perfluoroalkyl and Polyfluoroalkyl Substances, DeWitt, J. C., Ed. Humana Press: 2015; pp 451-477. (and references therein)
    2. Aquatic hazard, bioaccumulation and screening risk assessment for 6:2 fluorotelomer sulfonate. Chemosphere 2015, 128: 258-265.
    3. 6:2 Fluorotelomer sulfonate aerobic biotransformation in activated sludge of waste water treatment plants. Chemosphere 2011, 82(6): 853-858.
    4. Biotransformation potential of 6:2 fluorotelomer sulfonate (6:2 FTSA) in aerobic and anaerobic sediment. Chemosphere 2016, 154:224-230.
  - ii. Perfluorobutane Sulfonate (PFBS)
    1. Toxicology Data for Alternative "Short-Chain" Fluorinated Substances. In Toxicological Effects of Perfluoroalkyl and Polyfluoroalkyl Substances, DeWitt, J. C., Ed. Humana Press: 2015; pp 451-477. (and references therein)

- Widely reviewed and approved by national and regional competent authorities. Commercially available and purchased for use at global level for over a decade.

## 7. IPEN

- The POPRC considers this use to be an open application use of PFOS, indicating that it should be prioritized for phase-out. Parties registered for this use are: China, Czech Republic, EU, Norway, Republic of Korea, Switzerland, Turkey, and Vietnam. Both Vietnam and Zambia note that they are conducting an inventory of PFOS use and they may be able to withdraw acceptable purposes for this use based on their outcomes. At COP7, Canada reported declining use of PFOS in hard metal plating in closed loop systems until 2014 when the use was 0 kg. This suggests that Canada can withdraw its acceptable purpose for this use.

Despite the implication that this use is “controlled” by being in a “closed-loop system”, wastewater contains PFOS and sludge from sewage treatment can end up being used as a fertilizer on agricultural fields. In fact, the POPRC Guidance document states that, “A great part of the PFC used in this industry therefore probably ends up in the environment.” For these reasons, this use of PFOS should be prioritized for phase-out by converting it to a specific exemption.

The function that PFOS serves in hard metal plating is to lower the surface tension of the plating solution. The POPRC Guidance document notes that, “Non-fluorinated alternatives for hard chrome plating are available on the European market but are very new, and some are still being tested. These alternatives (whose chemical description and CAS numbers have not been released by the private sector) appear functional with some slight process changes including stirring the chromium bath.” In addition, the Guidance notes that, “The German national metal plating association (ZVO) describes the availability of PFOS-free alternative products from 10 German suppliers. Since the POPRC PFOS Guidance was prepared some time ago, it would be useful to re-investigate these alternatives and process changes to update the Guidance on their state of implementation.

A more recent investigation by the German Ministry of Environment notes various approaches to alternatives to PFOS in chrome plating. For example, “By using alkyl sulfonates and comparable fluorine-free surfactants, it should be possible within a relatively short period of time to completely do without the use of per- and polyfluorinated compounds in the majority of processes in electroplating.” The Ministry also recommends the need for incentives to accomplish elimination of PFOS for this use, stating that, “incentives are required so that more research is invested in the use and ecotoxicological assessment of fluorine-free substances...Supported by environmental authorities and by means of stakeholder hearings, test series resulting in product innovations and meeting with interest among companies, more PFC-free alternatives could be discovered, promoted and made more transparent for all actors involved. It is also assumed that a forced public promotion of the subject would greatly accelerate the process of substitution of PFOS in the electroplating sector. There is a need for subsequent action taking up the above issues.”

The Danish Ministry of Environment has also identified a variety of non-PFOS chemical alternatives (17) for use as mist suppressants in hard chrome plating, though the identity of some of them is known due to claims of proprietary information. The report notes that, “Talking to the different companies has shown that the non-PFOS based but fluorinated alternatives do work and some companies have used these alternatives for a long period.” Several non-fluorinated alternatives were also identified for use in hard chrome plating including SurTec850 SK4 and TIB Suract CR-H. Several physical alternative techniques were also noted including promoting condensation of the aerosol close to the electrolyte surface using a mesh solution and avoiding the transportation of aerosol from the surface of the electrolyte with a cover that prevents ventilation. The Ministry report notes that the latter solution would be possible for large-scale plating but more difficult for small-scale processes – though it could be accomplished with a significant redesign of the production line.

Finally, it appears that at least two countries that have used PFOS in hard chrome plating no longer permit the substance for that use, indicating technically feasible substitution. That makes it important to follow-up with Japan and Norway on developments in PFOS alternatives for this use.

Overall, it appears that there is active work on alternatives in this area and that feasible alternatives have been implemented. This suggests that a POPRC recommendation could be made to convert this acceptable purpose to a specific exemption so that a time limit for phase-out of this use can be established.

8. ZVO (including information on Metal plating (hard metal plating) and Metal plating (decorative plating) as specific exemption)
  - Multi- and polyfluorinated alternatives show some degradation, but as the amount of substances is rather low, this effect does not concern the economic viability too much. Non-fluorinated alternatives are not economically viable because their use causes additional risks with respect to safety, process stability and device preservation.
  - Multi- and polyfluorinated alternatives have substituted PFOS and its salts in most cases. They show similar technical feasibility with respect to quality and process stability. Non-fluorinated substances cannot be considered as reliable alternatives so far due to massive drawbacks in safety, process stability and device preservation.
  - Multi- and polyfluorinated alternatives are readily available meanwhile. There are no other reliable alternatives on the market at the moment.
  - Multi- and polyfluorinated alternatives are considered to cause similar risks to environment like PFOS and its salts. Additionally there is no way of retaining them entirely. While PFOS can be held back by activated carbon the alternatives are able to pass such filters significantly. Consequently most companies and local authorities would prefer returning to PFOS with the constraint of implementing activated carbon filters, that may hold back all PFOS and preventing it from being disseminated to environment – which is the only risk they cause!

- Multi- and polyfluorinated alternatives show some degradation, but as the amount of substances is rather low. As the effects, technical viability and economic viability are rather similar, no significant socio-economic impacts are expected. With returning to PFOS combined with suitable filter systems holding it back from dissemination the drawbacks may be overcome and the socioeconomic benefits will even raise. Other alternatives are not available.

Kurzbezeichnung	Summenformel	Rel. mol. Masse	CAS-Nr.	Fluor-Anteil
PFBA	C <sub>3</sub> F <sub>7</sub> CO <sub>2</sub> H	214,0	375-22-4	0,621
PFPeA	C <sub>4</sub> F <sub>9</sub> CO <sub>2</sub> H	264,0	2706-90-3	0,648
PFBS	C <sub>4</sub> F <sub>9</sub> SO <sub>3</sub> H	300,1	375-73-5	0,570
H4PFHxS	C <sub>4</sub> F <sub>9</sub> C <sub>2</sub> H <sub>4</sub> SO <sub>3</sub> H	328,2	757124-72-4	0,521
PFHxA	C <sub>5</sub> F <sub>11</sub> CO <sub>2</sub> H	314,1	307-24-4	0,666
PFHpA	C <sub>6</sub> F <sub>13</sub> CO <sub>2</sub> H	364,1	375-85-9	0,679
PFHxS	C <sub>6</sub> F <sub>13</sub> SO <sub>3</sub> H	400,1	355-46-4	0,617
H4PFOS	C <sub>6</sub> F <sub>13</sub> C <sub>2</sub> H <sub>4</sub> SO <sub>3</sub> H	428,2	27619-97-2	0,577
PFOA	C <sub>7</sub> F <sub>15</sub> CO <sub>2</sub> H	414,1	335-67-1	0,688
PFHpS	C <sub>7</sub> F <sub>15</sub> SO <sub>3</sub> H	450,1	357-92-8	0,633
PFNA	C <sub>8</sub> F <sub>17</sub> CO <sub>2</sub> H	464,1	375-95-1	0,696
PFOS	C <sub>8</sub> F <sub>17</sub> SO <sub>3</sub> H	500,1	1763-23-1	0,646
H4PFDS	C <sub>8</sub> F <sub>17</sub> C <sub>2</sub> H <sub>4</sub> SO <sub>3</sub> H	528,2	39108-34-4	0,612
PFDA	C <sub>9</sub> F <sub>19</sub> CO <sub>2</sub> H	514,1	335-76-2	0,702
PFDS	C <sub>10</sub> F <sub>21</sub> SO <sub>3</sub> H	600,1	335-77-3	0,665
PFUnA	C <sub>10</sub> F <sub>21</sub> CO <sub>2</sub> H	564,1	2058-94-8	0,707
PFDoA	C <sub>11</sub> F <sub>23</sub> CO <sub>2</sub> H	614,1	307-55-1	0,712
	C <sub>13</sub> F <sub>13</sub> H <sub>17</sub> N <sub>2</sub> O <sub>3</sub> S	528,3	80475-32-7	0,468
	C <sub>15</sub> F <sub>13</sub> H <sub>19</sub> N <sub>2</sub> O <sub>4</sub> S	570,4	34455-29-3	0,433

Figure 1: Examples of per- and polyfluorinated substances that may either been used as surfactant or be found as product of decomposition

## 5-2. Metal plating (decorative plating)

### 1. Galvano Röhrig GmbH (only on Metal plating (decorative plating) as specific exemption)

- Handelsname (trade name): Antifog CR; Oleylaminethoxylat 10-25%  
CAS: 26635-93-8; 1,2-propylen-glycol £ 2,5%  
CAS: 57-55-6; Substituierte Chemikalie:  
(substituted chemicals): -Chromprotekt FB Liquid ; Tensocrom 2; Verwendete Menge:  
(used amount): 1175 kg/a (2017); Ca. 0,55ml/Ah
- Economically viable. Galvano Röhrig was the first company which used Atifog CR. 8,00 – 13,40 € / kg (Abnahmemengen abhängig). (depends on ordered quantity)
- The product has an equivalent function. The alternative has a higher chemical consumption then the old products. The financial costs are higher as well. Since 2008 in use.
- The alternative is on the market and could be used immediately.
- GHS 05 Ätzwirkung, WGK 1

## **6. Certain medical devices (such as ethylene tetrafluoroethylene copolymer (ETFE) layers and radio-opaque ETFE production, in vitro diagnostic medical devices, and CCD colour filters)**

### **1. Canada**

- It is our understanding that use of alternative substances has been implemented such as Poly-paraxylylene (Parylene).

### **2. EU**

- While Japan has registered for this AP, according to the NIP, PFOS, or its salts, and perfluorooctane sulfonyl fluoride (PFOSF) were designated as Class I Specified Chemical Substance in April 2010 under the Chemical Substances Control Law, and their manufacture, import and use are virtually prohibited with no exception for this particular AP (Japan, 2016). Therefor the only countries registered and probably use this AP are China and Vietnam.

### **3. IPEN**

- The POPRC considers this use to be an open application use of PFOS, indicating that it should be prioritized for phase-out. Parties registered for this use are China, Japan and Vietnam. However, Vietnam notes that they are conducting an inventory of PFOS use and they may be able to withdraw acceptable purposes for this use based on their outcomes. In 2008, Japan stated that it would “take at least several years” to eliminate PFOS use in CCDs used in endoscopes. This suggests after a ten-year period has elapsed, that this acceptable purpose is no longer needed. Furthermore, a survey of PFOS use by the secretariat reported at COP7 did not indicate any use of this acceptable purpose by any Party.

The POPRC PFOS Alternatives Guidance notes that, “It is technically possible to produce PFOS-free CCD filters for use in new equipment.” The acceptable purpose was requested for the purpose of repairing existing equipment, but originally decided in 2009. This indicates that this acceptable purpose may no longer be needed, or at the very least could be converted to a specific exemption.

Alternatives are also available for PFOS use in ETFE products including PFBS. Clariant produces fluorine-free lubricants for catheters to reduce friction and they are incorporated into the polymer to reduce the possibility of migration into the body.

Finally, chlorodifluoromethane is used in ETFE synthesis in a pyrolysis step under high temperature. Chlorodifluoromethane is also known as HCFC-22 – the most commonly used refrigerant gas subject to the Montreal Protocol and a substance which must be completely phased out by 2030.

The POPRC should recommend ending the acceptable purpose for this PFOS use.

## **7. Fire-fighting foam**

### **1. Canada**

- Foams containing PFOS have not been manufactured in the U.S. or Europe since 2002. Substitutes to the use of PFOS in firefighting foams include C6 fluorotelomers as well as fluorine-free solutions. The actual C6 (or below) fluorosurfactants contained in AFFF formulations are considered proprietary by AFFF manufacturers.
- Furthermore, after 2000, significant developments were made to produce a new generation of firefighting foams that were fluorine-free. They contain water-soluble non-fluorinated polymer additives and increased levels of hydrocarbon detergents. Several types of fluorine-free foams are now available commercially in the marketplace.
- Some manufacturers and end-users have indicated that fluorine-free firefighting foams do not have comparable extinguishing effects as foams with fluorosurfactants. Compared to fluorine-based firefighting foams approximately twice as much water and foam concentrate are needed when

extinguishing liquid fires. Some analysis has indicated that fluorine-free firefighting foams may offer less protection against re-ignition, which makes it impossible to apply this alternative for some operations.

- It has been estimated that the cost of fluorine-free alternatives is approximately 5-10% higher than for fluorosurfactant foams. Based on information provided by a manufacturer of the fluorine-free alternatives, the cost would fall as market size increases.

## 2. EU

- PFOS-free fire-fighting foams are available but non-fluorinated alternatives often cannot achieve the stringent performance requirements. Short-chain fluorotelomer-based surfactants from various suppliers such as Chemguard, Chemours and Dynax (BAT/BEP task team, 2016) and other fluorinated chemicals like polyperfluorinated alkyl thiols and for class B fires mainly 6:2 fluorotelomer based (6:2 FTSAS (fluorotelomermercaptopalkylamido sulfonate) 6:2 FTAB (fluorotelomer sulfonamide alkylbetaine) are used (Kemi, 2015). Non-fluorinated alternatives exist and are in use but often cannot achieve the stringent performance requirements. According to the register of acceptable purposes the countries that claimed ongoing production and/or ongoing use are China, Vietnam, Canada, Cambodia, Switzerland, Zambia. Canada only allowed the use until May 2013 of PFOS - based aqueous film forming foams (AFFFs) (Canada, 2013). Cambodia uses existing stocks of AFFFs for emergency purpose (Cambodia, 2016).

## 3. Netherlands

- Fire-fighting foams: information on chemical composition of mixtures and the volumes of pre-installed amount of fire-fighting foam mixtures.
- We have not asked companies or organizations for the composition of fire-fighting foams. However, in December we had a general talk on the fire brigades in the Netherlands and the application of AFFF with an expert at RIVM.
- The Dutch fire-brigades are organized in 25 regions and generally use one type of foam within their region. The information on how foam is being used indicated that in installations are generally empty and that foam and water are mixed in case of an emergency. It was also indicated that the fire brigades are looking for alternatives for fluorine containing foams, but that specifically for covering chemical spills, the alternatives based on proteins are not always feasible. The expert we spoke to in December 2017 indicated that the European organization, CTIF (<http://www.ctif.org/>), and specifically people in the hazmat committee, may provide more information. The role of insurance companies and their regulations, which may prescribe fluorine containing foams for certain situations, was also indicated.
- Additional information available in Dutch (2015-02-16 finales Protokoll-01-03-2015; 2015-02-27-PFOA-comment to ECHA; 2016-06-18 Auszug Brandschutzkonzept; Anhang 1-Schaummittelanalyse; Anhang 2-Merkblatt fluorhaltige Schaummittel; Anhang 3-Pflichtenheft Schaummittel; Eingeladene Teilnehmer).

## 4. Fire Fighting Foam Coalition

- Firefighting foams based on fluorosurfactants derived from fluorotelomer intermediates were first developed in the mid 1970s and have been available as competitive alternatives to PFOS foams for 40 years. Most foam manufacturers have now transitioned to the use of only short-chain (C6) fluorotelomer surfactants. These short-chain (C6) fluorosurfactants are considered low in toxicity and not bioaccumulative according to current regulatory criteria. Foams that contain only short-chain (C6) fluorosurfactants are allowed for future use in final and proposed regulations on long-chain PFASs in the European Union, Canada and the United States. In addition, most foam manufacturers also produce fluorine-free foams that although less effective than fluorinated foams can provide a suitable alternative in some applications. Based on these facts, FFFC concludes that safe and effective alternatives to the use of PFOS, its salts, PFOSF and related compounds in firefighting foams are readily available worldwide, and therefore a specific exemption for the use of PFOS-based firefighting foams is no longer needed. Chemical Composition Fluorotelomer-

based foams do not contain or breakdown into PFOS or homologues of PFOS such as PFHxS (perfluorohexane sulfonate). Fluorotelomer-based AFFF agents have historically contained predominantly short-chain (C6) fluorosurfactants with formulations ranging from about 50–98% short-chain fluorosurfactants. Over the past few years most manufacturers have transitioned to only short-chain (C6) fluorosurfactants. This transition required most firefighting foam agents to be reformulated and requalified under the appropriate specifications. Fluorotelomer-based foams are not made with PFOA or any PFOA-based products, but may contain trace quantities as an unintended byproduct of the fluorosurfactant manufacturing process. Under the recently published REACH regulation on PFOA and PFOA-related substances, foams based on shortchain fluorosurfactants can contain no more than 25 ppb PFOA and 1000 ppb of a combination of PFOArelated substances in order to be sold in the European Union after July 4, 2020.

- Yes, economically viable. Fluorotelomer-based foams have been manufactured and sold for more than 40 years. There are numerous companies that sell fluorotelomer-based foams worldwide including the following FFFC members: Angus International (Angus Fire, National Foam, Eau & Feu, Kerr Fire), Dafo Fomtec, Dr. Sthamer, Fire Service Plus, Fire Safety Devices, ICL (Auxquimia), Orchidee Europe, KV Fire, Oil Technics, Profoam, Solberg, and Johnson Controls (Ansul, Chemguard, Sabo, Williams). Together these companies provide a significant percentage of the firefighting foam used worldwide.
- Yes, technically feasible. Fluorotelomer-based foams are the most effective agents currently available to fight flammable liquid fires in military, industrial, aviation and other applications. Firefighting foams are equally effective whether they contain PFOS-based fluorosurfactants or fluorotelomer-based fluorosurfactants. PFOSbased foams and fluorotelomer-based foams agents all meet the same material specifications of the International Standards Organization (ISO Standard 7203), Underwriters Laboratories (UL Standard 162), European Standard (EN-1568) and the US military (Mil-F-24385). PFOS-based foams and fluorotelomer-based foams have been used interchangeably in the same equipment and at the same concentration levels by military and industrial users in North America, Europe, Asia and many other parts of the world.
- Fluorotelomer-based foams are available on the market and accessible by foam users anywhere in the world.
- The industry is actively working to prevent firefighting foams from entering the environment when they used for training exercises, or when a discharge takes place during foam system testing, firefighting operations, inadvertent discharge or leakage, or disposal following decommissioning of a fire fighting system. If the discharge is not properly contained and treated, foam is likely to end up highly diluted in surface waterways, in subsurface water, absorbed into the ground, or evaporated. Over the past decade there has been an increased focus on reducing emissions of firefighting foam, especially from non-emergency activities such as testing and training. New methods have been developed to test foam systems and equipment without releasing foam to the environment, and non-fluorosurfactant foams are now available for training and other uses. The environmental impact of fluorosurfactants used in fluorinated foams has been extensively studied and a large body of data is available in the peerreviewed scientific literature. The bulk of this data continues to show that short-chain (C6) AFFF fluorosurfactants and their likely breakdown products are low in toxicity and not considered to be bioaccumulative or biopersistent according to current regulatory criteria. Groundwater monitoring studies have shown the predominant breakdown product of the short-chain (C6) fluorosurfactants contained in fluorotelomerbased AFFF to be 6:2 fluorotelomer sulfonate (6:2 FTS). A broad range of existing data on 6:2 FTS indicates that it is not similar to PFOS in either its physical or ecotoxicological properties. Recent studies on AFFF fluorosurfactants likely to break down to 6:2 FTS show it to be generally low in acute, sub-chronic, and aquatic toxicity, and neither a genetic nor developmental toxicant. Both the AFFF fluorosurfactant and 6:2 FTS were significantly lower than PFOS when tested in biopersistence screening studies that provide a relative measure of biouptake and clearance. Aerobic biodegradation studies of 6:2 FTS in activated sludge have been conducted to better understand its environmental fate<sup>9</sup>. These studies show that the rate of 6:2 FTS biotransformation was relatively slow and the yield of all stable transformation products was 19 times lower than 6:2 fluorotelomer alcohol (6:2 FTOH) in aerobic soil. In particular, it was shown that 6:2 FTS is not

likely to be a major source of perfluorocarboxylic acids or polyfluorinated acids in wastewater treatment plants. Importantly neither 6:2 FTOH nor PFHpA (perfluoroheptanoic acid) were seen in these studies. A review of the properties, occurrence and fate of fluorotelomer sulfonates was published in 2017. PFHxA is a possible breakdown product and contaminant that may be found in trace quantities in fluorotelomer-based AFFF. Extensive data on PFHxA presented in 2006 and 2007 gave a very favorable initial toxicology (hazard) profile. Testing was done on four major toxicology end points: sub-chronic toxicity in rats, reproductive toxicity in rats, developmental toxicity in rats, and genetic toxicity. Results show that PFHxA was neither a selective reproductive nor a selective developmental toxicant. In addition, it was clearly shown to be neither genotoxic nor mutagenic. In 2011 results were published from a 24-month combined chronic toxicity and carcinogenicity study, which demonstrated that under the conditions of this study PFHxA was not carcinogenic in rats and its chronic toxicity was low. An updated review of data on PFHxA presented in 2018 is shown in Figure 1.

- In 2014 an independent report was published that assessed several short-chain (C6) fluorinated chemicals with regard to the criteria used to define persistent organic pollutants (POPs). The report assessed these chemicals based on the four criteria that must be met to be considered a POP under the Stockholm Convention: persistence, bioaccumulation, potential for long-range transport, and adverse effects (toxicity and ecotoxicity). It concludes that none of the chemicals meets the criteria to be considered a POP, and at most they only meet one of the four criterion. The report also concludes that the three short-chain (C6) fluorotelomer intermediates and PFHxA "are rapidly metabolized and eliminated from mammalian systems. None of these materials appear to bioaccumulate or biomagnify based on laboratory data and available field monitoring data, and none show severe toxicity of the types that would warrant designation as POP." An update of this report was published in 2016. An extensive compilation of peer-reviewed and other relevant available data on short-chain PFASs can be found at the following link: <https://fluorocouncil.com/resources/research>
- Fluorotelomer-based firefighting foams currently protect lives and property from the hazard of flammable liquid fires in applications that are critical to society including aviation, military, and oil/gas production. Unfortunately, the use of legacy foams has resulted in groundwater contamination that also has socioeconomic impacts. Legacy contamination from the use of firefighting foams is largely the result of past practices where foam was discharged uncontrolled to the environment during training and the testing of foam equipment. Current best practice calls for the containment and treatment of foam discharges and the use of non-fluorinated fluids and methods for testing and training<sup>17</sup>. As fires are rare compared to testing and training exercises, implementing best management practices for all foam users has the potential to significantly reduce discharges of fluorochemicals to the environment from foam.

Figure 1

Short-Chain Fluorotelomers and Acids Toxicity Data Shows Significantly Higher No Effect Levels			
<ul style="list-style-type: none"> <li>Short-chain fluorotelomers can form short-chain PFAAs (PFHxA) upon degradation</li> <li>Extensive suite of toxicity studies available on PFHxA <ul style="list-style-type: none"> <li>NOAEL is ~10x higher, and does not bioaccumulate</li> </ul> </li> </ul>			
Toxicity Endpoints	Scientific Studies	Results	Summary
Cancer	✓ (Klaunig 2015; WIL Research Labs 2010)	No	<ul style="list-style-type: none"> <li>Not carcinogenic, not damaging to DNA, not genotoxic or mutagenic</li> <li>Not a developmental or reproductive toxicant</li> <li>Rapid bioelimination, not bioaccumulative</li> <li>Very low incidence of detection and quantification serum</li> <li>Not expected to be harmful to human health or the environment at environmentally relevant concentrations</li> </ul>
Repro/Developmental	✓ (Loveless 2009; Iwai 2014; Mukerji 2015)	No	
Chronic systemic toxicity	✓ (WIL Research Labs 2010)	NOAEL = 15 mg/kg-day*	
Sub-chronic systemic toxicity	✓ (Loveless 2009; Chengelis 2009)	NOAEL = 100 mg/kg-day Body weight	
Endocrine disruption	✓ (Borghoff in prep <sup>2</sup> )	No	
Bioaccumulation	✓ (Conder 2008)	No	
*Lowest PFOA NOAEL = 1.3 mg/kg-day Butenoff 2012; USEPA used a study with a LOAEL of 1 mg/kg-day			<sup>2</sup> Publication in Progress, presented as Poster at SETAC NA - 16 Nov 17

## 5. IPEN

- The POPRC considers this use to be an open application use of PFOS, indicating that it should be prioritized for phase-out. Parties registered for this acceptable purpose are: Cambodia, Canada, China, Switzerland, Vietnam, and Zambia. Several of these Parties may be able to withdraw their acceptable purposes for this use.
  - Switzerland notes that PFOS-based firefighting foams cannot be produced or used and that remaining stocks can be used in cases of emergency by fire brigades until 2014 and in stationary uses until 2018. This suggests that Switzerland can withdraw its acceptable purpose for this use.
  - Both Vietnam and Zambia note that they are conducting an inventory of PFOS use and they may be able to withdraw acceptable purposes for this use based on their outcomes.
  - The EU notes in their comments that PFOS-containing foams placed on the market before 27 December 2006 can only be used until 27 June 2011.

Since this use disperses PFOS directly to the environment, it should be prioritized for complete phase-out.

The POPRC PFOS alternatives document identifies fluorine-free fire fighting foams based on :

- Silicone-based surfactants, often used in combination with fluorosurfactants;
- Hydrocarbon-based surfactants, often used in combination with fluorosurfactants;
- Synthetic detergent foams, often used for forestry and high-expansion applications and for training (“Trainol”); new products with glycols (Hi Combat ATM from AngusFire);
- Protein-based foams (e.g. Sthamex F-15), which are less effective for flammable liquid fuel fires and are mainly used for training but also have some marine uses.

The PFOA Risk Management Evaluation acknowledges non-fluorine containing alternative firefighting foams are readily available. A variety of fluorine-free Class B foams are on the Swedish market indicating the technical feasibility of this alternative. “The firefighting foam Moussoll-FF 3/6 was introduced at a Swedish airport and is degraded to carbon dioxide and water in the environment. It is considered effective in fire suppression required at airports where high safety standards have to be fulfilled.” The Swedish Armed Forces began phasing out the use of perfluorinated substances in firefighting foam in Sweden in 2011.

The PFOA RME notes that “Norwegian airports, military properties and several offshore companies have also introduced fluorine-free foams (Comment Norwegian Environment Agency, 2017 on 3rd draft RME).”

Australian Defence commenced phasing out of 3M Lightwater in 2004 and the legacy AFFF containing perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) as active ingredients. Defence now uses Ansulite which they claim is a more environmentally friendly product that does not contain PFOS, PFOA or PFHxS as active ingredients but does contain trace elements of the chemicals. This is probably due to its proprietary mixture of hydrocarbon surfactants, fluorosurfactants, inorganic salts, high molecular weight, polysaccharide and water.

Since 2010, Air Services Australia responsible for fire management at Australian airports has used Solberg RF6, a PFAS-free alternative. The PFOA RME notes that the Queensland government acknowledged that “Lifetime costs for using AFFF, fluoroprotein (FP), or film forming fluoroproteins (FFFP) far outweigh those of fluorine-free foams just because of legal and financial liabilities of using a fluorochemical based foam (see Queensland Gov., 2016a and 2016b)”. There are also the extensive impacts of fluorochemical contamination on agriculture, fisheries, biodiversity and human health.

“Remediation costs are still substantial, especially off-site, compounded by high analytical and consultancy costs in the case of environmental contamination with fluorinated breakdown products from an AFFF, FP or FFFP (see e.g. Klein 2013).”

The Queensland Government in Australia, acknowledged that many fluorine-free foams are as “meeting the toughest amongst the firefighting standards and exceed film-forming fluorinated foam performance in various circumstances and that fluorine-free foams are widely used by airports and other facilities including oil and gas platforms (see Queensland Gov., 2016b).”

Examples include:

REHEALING RF6

Ecopol 100% fluorine free foam

Their website states that ZERO Fire Systems has a variety of foam concentrates in its product range. ECOPOL is being successfully used worldwide and is increasingly accepted as the new standard.

- i. 100% fluorine Free
- ii. 100% biodegradable 100% fluorine free and therefore PFOS and PFOA Free
- iii. Excellent strength and fire extinguishing ratings for both water soluble (such as alcohol or biodiesel) and non-water soluble substances (such as kerosene)
- iv. Used anywhere (in the industry, fire departments, airports, etc.)
- v. Frost resistant
- vi. Easy mixable with water
- vii. Compatible with existing standard nozzles, sprinklers and foam makers
- viii. At the lowest possible cost

ECOPOL is certified to:

- i. European standards: EN 1568 1-2-3-4
- ii. Oil industry: LASTFIRE - GESIP 3-3% (fresh and seawater)
- iii. Marine: VERITAS
- iv. High Expansion: APSAD R12
- v. Nuclear industry (PMUC)

- vi. Aviation: ICAO level B

Suitable for:

- i. Heavy, medium and light foam
- ii. Stationary systems (such as blending foam sprinkler system)
- iii. Mobile application (e.g., self-priming nozzle of a fire monitor)
- iv. Between mixer, foam pumps, bladder tanks

Technical information is available at:

- i. ECOPOL Safety Data Sheet
- ii. ECOPOL Technical Data Sheet

The PFOA RME acknowledges that “the institute for fire and disaster control Heyrothsberge in Germany tested six fluorine free alcohol resistant firefighting foams and one PFAS containing foam for their ability to extinguish fires of five different polar liquids. The authors conclude that there are fluorine-free foams available which show a similar performance compared with PFAS containing foams (see Keutel and Koch, 2016).”

“A wide range of fluorine-free foams which perform well in many firefighting situations are already on the market. Indeed, all Swedish and Norwegian commercial airports have recently replaced PFAS-based AFFFs with fluorine-free foams because of environmental safety concerns. Additionally, the USEPA has awarded their 2014 Designing Greener Chemicals Award to a fluorine-free firefighting foam based on a blend of hydrocarbon surfactants. Development of novel siloxane surfactants-based AFFFs is also underway, and these display nearly the same performance in fire tests as PFAS-Based AFFFs.”

At POPRC-13, an industry representative stated: “for training purposes, foams containing PFAS, including their fluorinated alternatives, must not be used” due to the risk of water pollution.

The POPRC should recommend ending the acceptable purpose for PFOS use in firefighting foams.

## 8. Insect baits for control of leaf-cutting ants from *Atta spp.* and *Acromyrmex spp*

### 1. Brazil

- No alternatives, taking into account technical feasibility, humans and environment effects, cost/effectiveness, availability and viability. (According to Guidance on General Considerations Related to Alternative and Substitutes for Persistent Organic Pollutants Listed and Candidate Chemicals-UNEP/POPS/ POPRC.5/10/Add.1)

Sulfluramid is, among the active ingredients, the best one with all features necessary for the good operation as an ant bait, which places it as the single efficient option to control leaf-cutting ants.

Currently, the active ingredients registered in Brazil for ant baits are sulfluramid, fipronil and chlorpyrifos. Chlorpyrifos as insect baits is no longer used in Brazil for control leaf cutting ants. According to the Brazilian Annex F information, sulfluramid cannot currently be efficiently replaced in Brazil by any other registered products commercialized since these alternatives have been questioned concerning their efficiency.

Additionally, Brazil had been tested for leaf-cutting ants fenoxycarb, pyriproxyfen, diflubenzuron, teflubenzuron, silanefone, thidiazuron, tefluron, prodrone, abamectin, methoprene, Hydramethylnon, boric acid, some insecticides from the group of neonicotinoids, pyrethroids, Spinosyns, etc., but they were not effective. An adequate insecticide used to formulate bait for the control of leaf-cutting ants should be lethal at low concentrations or otherwise prevent the ant feeding or reproducing and act by ingestion and present a delayed toxic action. Additionally, it should be odorless and non-repellent, so as to be dispersed by trophallaxis to most workers in the

colony. Since 1958, over 7,500 chemical compounds for ant control have been studied in many countries. Fewer than 1% of those 7,500 compounds have shown promise.

Several mechanical, cultural, biological and chemical methods have been studied as early as the 1950s for controlling leaf-cutting ants. Cultural management using resistant plants, plants toxic to ants, and applied biological management by manipulating predators, parasitoids and micro-organisms, have so far rendered unsatisfactory and inconsistent results, and have not provided technical, economic, or operational viability. However, research is continuing.

Mechanical control of leaf-cutting ants consists in excavating their nests for queen ant removal. Such a technique is no longer recommended for leaf-cutting colonies that are more than 4 months old, this is when the queen will be lodged at depths exceeding 1 meter, thus rendering the technique unviable due to the great effort required. In practice, mechanical control will be unviable in areas used for commercial plantations, in reforestation projects and grazing systems.

Cultural control has a conventional soil preparation by plowing and harrowing could mean the mortality of newly formed *Atta* nests. However, with the practice of minimum cultivation adopted in several cultivars and reforestation projects, such control has been abandoned. For adult *Atta* nests, the result could even be harmful, as soil mechanization could partially upset the anthill causing it to become temporarily inactive and giving the false impression of having been controlled.

Natural biological control, through predators: parasitoids and pathogenic microorganisms (fungi, bacteria and viruses), is of importance in regulating leaf-cutting ants but not to control in commercial plantations. Spiders, acarida, predating ants and beetles should also be mentioned. However, leaf-cutting ants has a complex biology, with a small number of progenies per female, such factors representing hindrances to control which causes low or none efficiency under field conditions.

No alternative economically viable. No alternative technically feasible. No alternative available on the market.

## 2. EU

- Brazil requested the registration of an acceptable purpose for the use of sulfluramid as bait insecticide to control the leafcutter ants *Atta* spp. and *Acromyrmex* spp. Sulfluramid is a PFOS-related substance that is not included in the PFOS definition of the Convention. Based on information from Brazil Sulfluramid was used in other applications than to control leaf cutting ants so probably this is also the case in other countries. Concerning alternative substances and techniques information is mainly available on ways to control the genus *Atta* with little information for the genus *Acromyrmex*. Alternatives including knowledge of alternative techniques, information on chemical identity and properties and on trade names and producers are available (cf. Table 14) but might be not suitable for all applications. Therefore further scientific studies and research should be undertaken to further reduce and eliminate the use of sulfluramide in the future.

## 3. ABRAISCA

- Take into account technical feasibility, humans and environment effects, cost/effectiveness, availability and viability (UNEP/POPS/ POPRC.5/10/Add.1) no alternative available.

The ants *Atta* and *Acromyrmex* are found only in America continent, covering large geographic area from the center of Argentina to the southern of United States. The leaf-cutting ants genus *Atta* are popularly known in Brazil as "saúvas", and of the genus *Acromyrmex* are known as "quenquéns". The success of this group of ants is related to their complex social organization in colonial life (living in large underground nests with up to 7 million of individuals and reach 8 thousand fungus growth chambers and depth of 8 meters), with the interaction between ant-plant-fungus and the great ability to promote hygiene strategies within their social complexity.

Leaf-cutting ants cut about 29% to 77% of plants in natural environments and also the exotic plants grown in agriculture, forestry and livestock are severely (suffer severe damage) attacked.

The great adaptive potential of this group intrigues and motivates researchers from around the world to seek knowledge about all aspects to these ants. Injuries caused by leaf-cutting ants to plants are historically reported in Brazil since 1560. Thus, there has always been concern for controlling leaf-cutting ants because of the great losses caused by these ants in tropical and neotropical regions.

The most studies of the losses caused by leaf-cutting ants have been made to plant species of economic importance in forestry such as *Eucalyptus* and *Pinus*. The estimated losses in wood are around 14% in areas with infestation of 4 colonies/ha. Plants totally defoliated represent between 13-50% losses productivity, considering that young plants may die after defoliation and successive attacks of leaf-cutting ants, the attacked plants may also have reduced the diameter and height.

Researches demonstrated that the colonies of *Atta* and *Acromyrmex* decrease the wood production by defoliation and destruction of apical meristems. Densities higher than 80 nests per hectare can reduce more than 50% of wood production. Leaf-cutting ants are nonspecific pest of cultivated plants in agriculture (grains, oilseeds, fruit, vegetables, tuberous roots, stimulant plants, sugarcane and ornamental), forestry (*Eucalyptus*, *Pinus*, *Hevea brasiliensis*, *Gmelina arborea*, etc.) and livestock (grasses in general). Grass-cutting ants also cause considerable losses in pastures and sugarcane. It was estimated that the leaf-cutting ants of grasses compete with cattle and can consume up to 639 kg of grass per ant colony per year, which is equivalent to the losses up to 870,000 head of cattle per year in state of São Paulo. In sugarcane losses, the amount is 3.2 tons of sugarcane per ant colony, each crop cycle and consequently a reduction of 30% of the sucrose content.

Losses caused by leaf-cutting ants, have motivated several research with different methods of control such as chemical and biological control, products of botanical origin and natural methods, since the end of 19th century.

Several mechanical, cultural, biological and chemical methods have been studied since early 50's for the control of leaf-cutting ants. The management of culture using resistant toxic plants and the applied biological management by manipulating predators, parasitoids and micro-organisms have rendered unsatisfactory and inconsistent results, and have offered the indication of any technical, economic or operational viability. With the development of synthetic insecticides, chemical methods have been effectively used to control ants genus *Atta* and *Acromyrmex*.

It is desirable that other methods and products are developed for the use in chemical control of leaf-cutting ants, although currently use of insect bait with the active ingredient with delayed action on a wide range of concentrations, it is sufficient, viable and efficient. It is extremely time consuming and difficult to find new active ingredients that are viable and efficient, because the limitations are great and the need of the active ingredient have as essential features: the action by ingestion, be odorless and non-repellent, present a toxic delayed action, be lethal at low concentration and paralyze the plant cutting activities, in the first days after application.

Added to these difficulties the inefficiency of the ant queen sterilizing active ingredients, insect growth regulators, or chitin synthesis inhibitors. The causes of this difficulty are still far from being fully understood. Efficient toxic bait should enable the control of 100% of the colonies under experimental conditions and the successful preliminary tests in laboratory colonies, often not happen the same in field. Only two active ingredients, dechlorane and sulfluramid showed full efficiency in the control of leaf-cutting ants, wherein the first is no longer used. Currently the sulfluramid is the only active ingredient registered for the control of leaf-cutting ants, efficient for all species.

Chemical control with toxic baits is still the only one that has technology available to control leaf-cutting ants genus *Atta* and *Acromyrmex* with technical, economic and operational viability. Toxic baits use active ingredients in very low concentration in the form of pellets. Beyond efficiency, it has great advantage over other methods such as low cost, high performance and low hazard to humans and the environment. Sulfluramid is among the active ingredients currently registered in Brazil, the only one who has all the characteristics necessary to proper functioning of a toxic bait, which places it as the only effective option to control leaf-cutting ants. Therefore, maintaining this

active ingredient is essential, at the risk of a dangerous setback in the control of leaf-cutting ants such as pest population growth and huge losses to the Brazilian agribusiness, if sulfluramid production is discontinued.

Two other chemical methods are used in Brazil as complementary form to insect bait to the control of leaf-cutting ants: the use of dried powder formulations and thermonebulizable solutions (thermal fogging). The use of dried powder formulations are limited in a few regions of the country and far from being used widely.

These are recommended only as complementary form in very specific situations, for example, to control some species of *Acromyrmex* colonies and initial colonies of *Atta*. The dried powder formulations are applied with manual dusters in a low efficiency and often at the application process occurs clogging at the nests tunnel and the pesticide does not reach the fungus chambers and the ants. Another problem is related to soil moisture, if the ground is wet the product adheres to the walls of the tunnels and does not reach the target. Furthermore, there is the need to remove loose soil before application of the product, which makes the technique impractical operatively. Another limitation is the risk of contamination of the environment and the operator.

The thermonebulizable solutions is also used in very specific situations as a complementary method the use of insect baits, it has high cost compared to insect baits and can only be used to mature nests of *Atta* and it is impossible to control *Acromyrmex* nests.

The method has operating and economic disadvantages, but the most serious problem is the great exposition of workers to insecticide, which is liable to be easily inhaled during the handling of machines. Among the various types of potential dangers of using insecticide thermonebulizable solutions to control leaf-cutting ants, it is associated with soil contamination that had remained unknown, though recently demonstrated that the process of thermonebulizable solutions contaminates the soil. Considering that the insecticides used are formulated at high concentrations of active ingredients, we can assume that the use of this method is much more impactful to the environment than the use of insect baits.

Other limitations are: high cost of the equipment, operational problems and maintenance of the equipment, risk of fire in forests and pasture due to equipment to produce sparks at the beginning of the process and at the turn off there is even the possibility of leaving a flame of fire of the injector pipe.

Given the limitations assessed by these formulations (dried powder formulations and thermonebulizable solutions), it is clear that they cannot be recommended as principal and not the only method of control leaf-cutting ants and cannot be considered as substitutes to the use of insect baits.

Deltamethrin, fenitrothion and permethrin are registered and used in Brazil as a complementary form, in a very specific way for the control of leaf-cutting ants in the form of thermonebulizable solutions (fenitrothion and permethrin) and in dried powder formulations (deltamethrin) and cannot be considered a substitute or alternative to the use of sulfluramid as an insect baits.

The colonies of leaf-cutting ants consist of a mutualistic system composed of ant-symbiotic fungus-mutualistic bacteria, filamentous microfungi and lots of other species of bacteria and yeasts. So far there is no feasible alternative that can use all this knowledge produced by science to practice. All attempts to use entomopathogenic fungi to control leaf-cutting ants resulted in failure. Natural enemies, including predators (birds, mammals, amphibians, reptiles, beetles, other ants), the parasitoids (Phoridae flies) and nematodes, also did not produce effective control in the results, although they occur in nature and contribute to reducing the mortality of the ant queens and consequently the foundation of new colonies, however it is not known what is the specie or keystone species that cause mortality.

Although several literature review in scientific papers point biological control as an alternative to leaf-cutting ants, in practice there is no nomination process, method or product that can be used, that is feasible, efficient and commercially available. Summarizing and, against facts noted in the

literature, biological control, whether applied or natural, is unfeasible and impracticable nowadays and is far from being used within the concept of Integrated Pest Management.

Not much is known about the active ingredients extracted from toxic plants surveyed for leaf-cutting ants. These are complex substances, unstable and difficult synthesis in the laboratory, without any technical feasibility light of current knowledge. The trials (98%) were conducted in laboratory and few studies and experimental in field do not allow to draw conclusions about the effectiveness of these treatments. Countless methodological errors were detected in scientific articles, and the lack of standardization on the purity and concentration of the substances. Until now there is no substance or commercial product available. Probably brought decades until researches can master this technology with toxic products of botanical origin for control of leaf-cutting ants.

The idea of being able to facilitate the control of leaf-cutting ants with preferred and non-preferred plants, incorrectly named as resistant plants, it has been investigated by several researchers since 1980, and little is known about the mechanisms of such selection. The *Eucalyptus* species were the most investigated, but it is not known the mechanism called "resistance", is antixenosis or non-preference, antibiosis or tolerance. Numerous factors affect the selection of plants by cutting ants, and many conclusions have been obtained from trials with inadequate methodologies. The effectiveness of the method is doubtful, and at this moment any species or resistant lineages cannot be recommend, because they are not available at the market such as technological package ready for purchase.

Cultural practices such as crop rotation, plowing, harrowing, use of fertilizers and lime, the destruction of young nests with the death of ant queen, composting use, plant consortium, and others have no practical viability, has no proven efficiency and has not innovative technologies available and affordable on the market. Some cultural practices that reduce tillage (minimum tillage farming) can increase the number of nests of leaf-cutting ants. Maintaining the understory and native vegetation strips can reduce the number of nests, but they need to be thoroughly tested before being recommended, and we consider that studies are still in the research phase.

The control of leaf-cutting ants within the approach of Integrated Pest Management (IPM), can not be done today, because there is no effective method available on the market unless the chemical control, so it is not possible to use two or more tactics (methods) of control, as set at IPM. The others reviews of leaf-cutting ants control methods suggest that the candidates to be alternatives to chemical control (biological, compounds of toxic plants, mechanical and cultivation methods), are still being studied so it means that they are not available and ready to use. In addition, efficacy data for the candidates to be alternatives to chemical methods are scarce variable and inconsistent. Furthermore, the chemical control with toxic baits with sulfluramid provides high levels of efficiency. Ideally for the future is the implement of the Integrated Pest Management for each culture as in *Eucalyptus* spp. cultivated forests, but especially for leaf-cutting ants is necessary that other efficient control methods are available in the market for farmers.

The Integrated Pest Management program (IPM) must combine two or more control compatible methods, which used together, produce excellent management. Additionally, the directive 2009/128/Ec of the European Parliament determines that is need to make a careful analysis of all methods of control, integrating them, so that they can be economically and environmentally justified, reducing or minimizing risks to human health and the environment.

In the light of current knowledge it is believed that the future in control of leaf-cutting ants remain exclusively chemical and the commercial formulation is toxic bait, because of the limitations of other formulations. The current view of the so-called Integrated Management of leaf-cutting ants is simply the rational use of control with toxic baits, far from the ideal of the IPM approach, and is closer to the supervisory control of ideas of the 1940s. This approach is not necessarily bad, because it encourages the wise use of chemical control, but we must to make plans for the future to enable the possibility for to control leaf-cutting ants inside the IPM vision and address efficient and innovative study methods for the better understand the mechanisms that enable a control method to be efficient.

See references: BRITTO, J. S.; FORTI, L. C.; OLIVEIRA, M. A.; ZANETTI, R.; WILCKEN, C. F.; ZANUNCIO, J. C.; LOECK, A. E.; CALDATO, N.; NAGAMOTO, N. S.; LEMES, P. G. and CAMARGO, R. S., 2016. Use of alternatives to PFOS, its salts and PFOSF for the control of leaf-cutting ants *Atta* and *Acromyrmex*, *International Journal of Research in Environmental Studies* (2016) 3(2):

Sulfluramid is, among the active ingredients, the best one with all features necessary for the good operation as an ant bait, which places it as the single efficient option to control leaf-cutting ants, taking into account technical feasibility, humans and environment effects, cost/effectiveness, availability and viability.

Currently, the active ingredients registered in Brazil for ant baits are sulfluramid, fipronil and chlorpyrifos. Chlorpyrifos as insect baits is no longer used in Brazil for control leaf cutting ants. According to the Brazilian Annex F information, sulfluramid cannot currently be efficiently replaced in Brazil by any other registered products commercialized since these alternatives have been questioned concerning their efficiency.

Currently, the active ingredients registered in Brazil for producing bait to control leaf-cutting ants are sulfluramid, fipronil and chlorpyrifos. The latter two, however, are considered more acutely toxic to humans and the environment than sulfluramid. Furthermore, the effectiveness of these substances has been questioned; thus new alternatives are being studied in Brazil. According to the Brazilian Annex F information, sulfluramid cannot currently be efficiently replaced in Brazil by any other registered products commercialized for the same purpose.

Additionally Brazil consider not to use sulfluramid as the main active ingredient in insect baits is a dangerous retrocession in the leaf-cutting ant control, with the use of products or methods with less or no efficiency, more toxic to human beings and with animals and higher environmental impact risk.

According to Brazil there are many differences between leaf-cutting ants and exotic ants (urban ants), including in alimentary behaviour. Such differences explain why certain active ingredients are effective for controlling urban ants and not for controlling leaf-cutting ants.

Additionally according to Brazil, fenoxycarb, pyriproxyfen, diflubenzuron, teflubenzuron, silanefone, thidiazuron, tefluron, prodrone, abamectin, methoprene, Hydramethylnon, boric acid, some insecticides from the group of neonicotinoids, pyrethroids, Spinosyns, etc., had been tested for leaf-cutting ants, but they were not effective. An adequate insecticide used to formulate bait for the control of leaf-cutting ants should be lethal at low concentrations or otherwise prevent the ant feeding or reproducing and act by ingestion and present a delayed toxic action. Additionally, it should be odorless and non-repellent, so as to be dispersed by trophallaxis to most workers in the colony. Since 1958, over 7,500 chemical compounds for ant control have been studied in many countries. Fewer than 1% of those 7,500 compounds have shown promise.

According to Brazil active ingredients applied in the dried form and emulsifiable concentrates form are not efficient for the leaf-cutting ants control, in view of aspects related to the biology and behavior of said insects and others, such as the size of nests and operating difficulties. In addition, the utilization of dried powders and emulsifiable concentrates presents enormous toxicological and environmental disadvantages (risks to applicator and the environment), comparing to the application of insect baits. Granulated baits is a low-cost method, delivering high efficiency with reduced health hazards to humans and the environment during application and being specific to the pest target. Its formulation is developed with low concentrations of active ingredients, and its localized application does not require application equipment. Baits are directly distributed from their packaging, with no manual contact, close to active nest entrance holes or anthill trails and carried into the colony by the ants themselves. The utilization of ready-to-use formulations should reduce or impede primary exposure to humans.

Several mechanical, cultural, biological and chemical methods have been studied as early as the 1950s for controlling leaf-cutting ants. Cultural management using resistant plants, plants toxic to ants, and applied biological management by manipulating predators, parasitoids and micro-organisms, have so far rendered unsatisfactory and inconsistent results, and have not provided

technical, economic, or operational viability. However, research is continuing. (UNEP/POPS/POPRC.12/INF/15/Rev.1).

No alternatives, taking into account technical feasibility, humans and environment effects, cost/effectiveness, availability and viability. (according to Guidance on General Considerations Related to Alternative and Substitutes for Persistent Organic Pollutants Listed and Candidate Chemicals-UNEP/POPS/ POPRC.5/10/Add.1)

It is believed that the future of the control of leaf-cutting ants will continue to be the chemical method, taking into account that it's still the only one with proven efficiency, available in the market at low cost and accessible to a wide range of consumers.

Candidate alternative methods to chemical control, such as biological control using predators, parasitoids, microorganisms or way to increase the action of the natural enemies, use of extracts of plants or insecticides/fungicides of botanical origin, or non-preferred species cultivars, use of crop control (diversification of crop systems, trap crops, crop rotation, soil plowing and harrowing, use of fertilizers, etc.) are still being researched, and none of them are currently available in the market, and they do not have its efficiency proven in pilot tests and in operational conditions.

Methods that do not use synthetic chemicals, as biological applied or conservative, non-preferred ("resistant") plants, extracts of toxic plants or active ingredients of botanical origin, crop control, have produced poor, inconsistent results, without the indication of technical, economical and operational feasibility, although many projects have been developed in research institutions and universities. It seems there will be no recommendations and products available on a short term. For example, a project developed in Brazil for studies on natural products of botanical origin with insecticidal/fungicidal potential, financed by an institution that incentives research in partnership with universities, after 25 years and despite many efforts spent on research, they found substances with low success expectations, considering that 98% of the experiments were conducted in laboratory. Studies with biological control are more focused in the entomopathogenic fungi, and the results obtained, however, having been showing inconsistent, also demonstrating their technical, economical and operational infeasibility.

The remaining chemical control formulations, such as dry powder and thermal fogging, may not be considered as substitutes to toxic baits, but as their supplement in very specific situations. The toxic bait, like the sulfluramid is the most used formulation and shows full efficiency in the control of leaf-cutting ants and grass-cutting ants.

An active ingredient candidate to replace the sulfluramid in the manufacturing of toxic baits should show particular features in its control efficiency: must act on ingestion, be odorless and non repellent, show delayed toxic action, be lethal in low concentrations and paralyze the cutting activity (injuries or damage caused by the ants), right after the first days of its application. Active ingredients, such as the fipronil and other phenylpyrazoles used in the toxic bait formulation, do not show chances of replacing the sulfluramid because they add limitations. Therefore, the need for maintenance in the use of sulfluramid until another active ingredient is found with the desirable features, like other products registered and marketed for that control, are not efficient options.

Probably, monitoring (survey of the number of nests/ha) will continue to be used exclusively in planted forests with species of Eucalyptus and Pinus with the purpose of reducing the need for use of hand labor and insecticide in the toxic bait formulation.

Decision making in the control of the cultivation of species of Eucalyptus has the purpose of determining the moment to perform chemical control; therefore it is just the rational use of chemical control, and is not considered within the ideal approach of Integrated Pest Management. Thus, that "supervised control" is not necessarily bad, taking into account that the careful use of the insecticides should be encouraged. The biggest issue in the future with that vision is that it perpetuates the idea of the "quick-fix mentality" and so we are not able to implement the true "Integrated Pest Management". Thus, in the future, one must invest in research so that other technologies such as: biological control, insecticides of botanical origin, resistant plants, crop methods and others, may become efficient, market competitive and be available to consumers.

Thus, only in the future, when other control methods are available in the market with proven efficiency, will we be able to use the integration of various methods as advocated by the principles of Integrated Pest Management.

Taking into account that chemical control is the only efficient control method available, so it is not possible to use the principles of Integrated Pest Management in order to promote the control of leaf-cutting ants within that approach in light of the current knowledge.

See references: BRITTO, J. S.; FORTI, L. C.; OLIVEIRA, M. A.; ZANETTI, R.; WILCKEN, C. F.; ZANUNCIO, J. C.; LOECK, A. E.; CALDATO, N.; NAGAMOTO, N. S.; LEMES, P. G. and CAMARGO, R. S., 2016. Use of alternatives to PFOS, its salts and PFOSF for the control of leaf-cutting ants *Atta* and *Acromyrmex*, *International Journal of Research in Environmental Studies* (2016) ) 3(2)

#### 4. IPEN

- The POPRC considers this use to be an open application use of PFOS, indicating that it should be prioritized for phase-out.

An active ingredient of sulfluramid, N-ethyl perfluorooctane sulfonamide (EtFOSA), is a precursor of PFOS. EtFOSA is taken up by carrots (*Daucus carota* ssp *sativus*) and transformed into PFOS with yields up to 34% if a technical EtFOSA formulation was used and 277% if a commercial sulfluramid bait formulation (Grao Forte) was used. Other transformation substances that were formed included perfluorooctane sulfonamido acetate (FOSAA), perfluorooctane sulfonamide (FOSA), and perfluorooctanoic acid (PFOA). The authors concluded that, "These data collectively show that the application of Sulfluramid baits can lead to the occurrence of PFOS in crops and in the surrounding environment, in considerably higher yields than previously thought." This study indicates that the continued use of sulfluramid has the potential to contaminate crops with PFOS and represents a potential pathway for human exposure.

The PFOS Alternatives Guidance describes a number of alternatives to sulfluramid.

In laboratory studies, the entomopathogenic *Metarrhizium anisopliae* can cause the decline and ultimate death of small colonies and recent research indicates that the entomopathogenic fungi *Beauveria bassiana* and *Aspergillus ochraceus* both show a high degree of control, causing 50% mortality within 4 to 5 days. , Effective natural products include limonoids extracted from the roots of the South Brazilian endemic plant *Raulinoa echinata*. The entomopathogenic *Metarrhizium anisopliae* can cause the decline and ultimate death of small colonies and recent research indicates that the entomopathogenic fungi *Beauveria bassiana* and *Aspergillus ochraceus* both show a high degree of control, causing 50% mortality within 4-5 days. One of the largest studies of parasites associated with leaf-cutting ants demonstrates a new possible non-chemical control method for these two species of leaf cutting ants in the form of specialized parasites. *Escovopsis* is a group of parasites that attack the fungal crops raised by the ants. Interestingly, a variety of forms of *Escovopsis* are present in the same ant colony and the parasite has the capability to invade distantly-related fungus-growing ant species, including those found in Brazil. In 2011 a new natural ant bait called Cocapec was registered in Brazil . The baits, based on saponins and flavones from the plant *Tephrosia candida*, also contain an extract from the plant *Psychotria marcgravii*, organic soybean oil and citrus pulp. The baits were developed by a cooperative of farmers and ranchers of the High Mogiana region, based in Franca/SP, which has more than 2,200 members and a total area of 60,000 hectares of coffee. The herbal formulation is highly attractive to ants, which carry it inside the nest without intoxication, inserting it into the internal food system. Its fungicidal action eliminates the fungus that coexists with the ants, spoiling the food base of the nest resulting in its extinction. Cocapec is approved for use on organic farms, without efficacy studies. Since the new protocol for leaf cutting ants control was established by Ministry of Agriculture in 2009 to prove the efficacy for a regular registration of pesticides use the register of this product was cancelled, because they didn't provide the new studies of efficacy. However it is recommended for organic farms, assuming its efficiency. More research is needed to verify if this product can be efficient in the leaf cutting ant control. Research

in Costa Rica showed that increasing plant diversity in coffee plantations reduced leaf loss to leaf cutting ants from 40% in monocultures to <1% in farms with complex plant diversity.

The high yields of PFOS from sulfluramid use; its potential to contaminate food crops; and the availability of promising alternative controls should result in a POPRC recommendation to convert this acceptable purpose to a specific exemption so that a phase-out period can begin.

## 5. PAN

### 3. Alternatives

#### 3.1 Bioisca

Bioisca is a biological alternative to sulfluramid, developed in Brazil and based on an extract of the leguminous plant *Tephrosia candida* (white hoarypea). It is a granulated bait approved in Brazil for use by organic farmers against the ant species *Atta sexdens rubropilosa* (saúva-limão) and *Atta laevigata* (saúva cabeçade-vidro).<sup>21</sup> It is highly attractive to ants, which carry it into their nests. It has a fungicidal action that eliminates the fungus that leaf-cutting ants cultivate to break down hard-to-digest plant material. The product was approved by ANVISA in 2010, registered by the Ministry of Agriculture in 2011, and in 2015 certified as an organic product by Biodynamic. Application rate is recommended at 10 gms/m<sup>2</sup>. Efficacy of the product has been validated in various regions of Brazil.

#### 3.2 Pathogenic fungi *Escovopsis* sp.

A 12-year study by Meirilles et al (2015) of sites in Brazil (22 sites), Panama (four sites), the Caribbean island of Guadeloupe (one site), Argentina (one site) and Mexico (one site) has identified 61 strains of *Escovopsis* parasitic fungi infecting the fungal gardens of leaf-cutting ant species, that show promise as potential biological control agents of leaf-cutting ants although more research is needed to confirm this potential.<sup>22</sup>

#### 3.4 Pathogenic fungi *Syncephalastrum* sp

The pathogenic fungus *Syncephalastrum* sp. shows considerable potential as a biological control for leaf-cutting ants. In a controlled experiment, various strains of *Syncephalastrum* sp., isolated from fungus gardens of colonies of *Atta sexdens rubropilosa* reared in a laboratory and which had been treated with sulfluramid, were introduced to sub-colonies containing workers and fungus garden sampled from a mature *A. sexdens rubropilosa* colony (14 years old) maintained at the Centre for the Study of Social Insects.<sup>23</sup> The sub-colonies inoculated with *Syncephalastrum* sp. spores developed an infection, and although this was recognised by worker ants, which then removed contaminated fragments from the fungus garden, they were unable to remove sufficient of it. All *Syncephalastrum* sp. strains inhibited the mycelial growth of *Leucoagaricus gongylophorus* when compared with the control. *L. gongylophorus* is a mutualistic fungus that leaf-cutter ants maintain to obtain food: *L. gongylophorus* converts plant polysaccharides into glucose, which is consumed by leaf-cutter ants. Sub-colonies treated with spores of the *Syncephalastrum* sp. strain LESF 127 exhibited a significant decline in foraging activities compared with the control from the 3rd day, and were interrupted on the 11th day. Ant mortality increased significantly relative to the control on the fifth day, and all workers died in the 13th day. Sub-colony deterioration had already begun on day 1, and sub-colony death occurred on day 13. In response to *Syncephalastrum* sp. infection, worker ants ceased foraging and leaf-fragment incorporation activities, and removed a large amount of fungus garden fragments, leading to garden decay. Thus, it appears that fungus garden deterioration is a complex outcome resulting from pathogen-mediated damage in association with host-mediated damage. Sub-colonies treated with the spores of both *Syncephalastrum* sp. and *Metarhizium anisopliae* had significantly lower foraging activity, compared with the control, from the 3rd day, and these activities were completely interrupted by the 9th day. Ant mortality increased significantly from the 3rd day, with total mortality on the 11th day. Sub-colonies deteriorated significantly relative to the control from the 1st day, and the death of the fungus garden occurred on the 8th day.

#### 3.3 Biodiversity

On-farm biodiversity dramatically reduces the damage caused by leaf-cutting ants. In a study of coffee farms in Costa Rica, the provision of complex shade reduced leaf lost from 40% experienced in coffee monocultures to <1%. The ant species *Atta cephalotes* L. significantly

preferred the leaves of the predominant shade tree *Erythrina poeppigiana* to those of coffee plants. Hence, an integrated approach involving improvements in on-farm diversity in conjunction with biological controls such as the pathogenic fungi described above have the capacity to reduce damage by leaf-cutter ants below the economic threshold, such that sulfluramid and other chemical interventions would no longer be necessary.

#### **4. Benefits of leaf-cutting ants**

Leaf-cutting ants have developed anti-fungal bacteria, which they store on their bodies, to preserve their food-digesting fungi. Scientists have identified these bacteria as a promising new source of antibiotics for human use.

### **10. Photo masks in the semiconductor and liquid crystal display (LCD) industries**

#### **1. EU**

- According to the register of SEs China and Korea claimed ongoing production and/or ongoing use. From the NIPs, ongoing use was reported from United Kingdom. Information on alternatives is available but chemical identity and properties, and trade names and producers were not identified. According to industry information this use has been eliminated.

### **11. Electric and electronic parts for some colour printers and colour copy machines**

#### **1. EU**

- No detailed information is available on alternatives, chemical identity and properties and trade names and producers. According to the register of specific exemptions China and Korea claimed ongoing production and/or use.

### **12. Insecticides for control of red imported fire ants and termites**

#### **1. EU**

- Commercially available alternatives and technologies are on the market, information on chemical and non-chemical alternatives, chemical identity/properties and trade names and producers are available. According to the register of SEs China and Korea claimed ongoing production and/or use. No other country reported continuous need for this SE.

### **13. Chemically driven oil production**

#### **1. EU**

- Information on alternatives, on chemical identity/properties and trade names/producers is available but quite limited. Perfluorobutane sulfonate (PFBS) based substances and telomer-based fluorosurfactants were identified as used alternatives. According to the register of SEs China and Korea claimed ongoing production and/or use. No other country reported continuous need for this SE.

### **14. Carpets, leather and apparel, textiles and upholstery, paper and packaging, coatings and coating additives, rubber and plastics**

#### **1. EU**

- According to the register of specific exemptions no countries claimed ongoing production and/or ongoing use. Since no new registrations pursuant to para 9 Article 4 SC COP7/4/Rev.1 are available, these specific exemptions are considered outdated that indicate that alternatives are in place.

#### **2. Stockholm Convention text and decision**

- Currently there are no Parties registered for those specific exemptions. By decisions SC-7/1, the Conference of the Parties noted, pursuant to paragraph 9 of Article 4, that as there are no longer any Parties registered for specific exemptions for the production and use of PFOS, its salts and

PFOSF for carpets, leather and apparel, textiles and upholstery, paper and packaging, coatings and coating additives and rubber and plastics, no new registrations may be made with respect to them.

## 14-1. Carpets, leather and apparel, textiles and upholstery

### I. FluoroCouncil

- **Fluorinated Alternatives**

Two alternative fluorinated technologies are in global use that provide oil- and water- repellent and -stain release properties for Carpets, Leather and Apparel, and Textiles and upholstery.

Short-chain fluorotelomer-based side chain fluorinated polymers (aka “C6”). These are generally high molecular-weight acrylic polymers that contain 6:2 fluorotelomer functionality to provide repellent performance.

Examples of Suppliers who offer these products commercially and their websites:

- i. Daikin: <https://www.daikin.com/chm/products/fiber/index.html>
- ii. Asahi: <https://www.agc-chemicals.com/jp/en/fluorine/products/detail/use/index.html?pCode=JP-EN-F001>
- iii. Chemours: [https://www.chemours.com/Capstone/en\\_US/uses\\_apps/textiles/index.html](https://www.chemours.com/Capstone/en_US/uses_apps/textiles/index.html)
- iv. Archroma: <http://www.bpt.archroma.com/products-services/finishing/repellency-soil-release/>
- v. Fuxin Heng Tong Fluorine Chemicals Co. Ltd: <http://www.htfluo.us/>
- vi. Nicca: [http://www.niccausa.com/product\\_data\\_sheet/ni-805/](http://www.niccausa.com/product_data_sheet/ni-805/)
- vii. Jintex: [http://www.jintex.com.tw/en/product\\_unit.php?pid=1&uid=272](http://www.jintex.com.tw/en/product_unit.php?pid=1&uid=272)
- viii. Rudolf Chemie: <http://www.rudolf.de/en/products/textile-auxiliaries/finishing/>

Short-chain electrochemical fluorination-based side chain fluorinated polymers (aka “C4”). These generally are high molecular-weight acrylic polymers that contain perfluorobutane sulfonyl functionality to provide repellent performance.

Examples of a Supplier who offer these products commercially and their websites:

- i. 3M: [https://www.scotchgard.com/3M/en\\_US/scotchgard/built-in-protection/](https://www.scotchgard.com/3M/en_US/scotchgard/built-in-protection/)
- ii. FluoroCouncil reference to “one-pager”: <https://fluorocouncil.com/wp-content/uploads/2017/03/Apparel-Resources-1.pdf>

- **Non-Fluorinated Alternatives**

A large number of global suppliers are offering “non-fluorinated” durable water repellent products. These alternatives generally do not provide oil repellency or oily stain protection. These are used commercially on a global basis where the performance (water repellent) is suitable for the intended use of the consumer product. A recently completed multi-party project called SUPFES looked in to this (<http://www.supfes.eu/ProjectInfo.aspx>).

Widely purchased and commercially available at global level. Short-chain alternatives have been adequately reviewed and approved by multiple competent regulatory authorities worldwide.

Short-chain fluorinated alternatives have been on the market and extensively used as efficient alternatives for over a decade. Fluorinated alternatives uniquely provide both oil and water repellency as well as water and oily stain protection.

A large number of global suppliers are offering “non-fluorinated” durable water repellent products. These alternatives generally do not provide oil repellency or oily stain protection. These are used commercially on a global basis where the performance (water repellent) is suitable for the intended use of the consumer product. A recently completed multi-party project called SUPFES looked in to this (<http://www.supfes.eu/ProjectInfo.aspx>).

Available globally and approved by regulators. Short-chain alternatives have been adequately reviewed and approved by multiple competent regulatory authorities worldwide.

Summaries of the environmental fate and health risk data associated with several key short-chain fluorotelomer substances can be found in the documents below:

- i. <https://fluorocouncil.com/wp-content/uploads/2017/08/2014-ENVIRON-Report.pdf>
- ii. <https://fluorocouncil.com/wp-content/uploads/2017/08/2016-Ramboll-ENVIRON-Report.pdf>

FluoroCouncil reference to

- i. BAT/BEP document: <https://fluorocouncil.com/wp-content/uploads/2017/03/FluoroCouncil-Textile-BEP-Guidance-English-Resources-1.pdf>

Summaries of the environmental fate and health risk data associated with several key short-chain fluorotelomer substances can be found in the documents below:

- i. <https://fluorocouncil.com/wp-content/uploads/2017/08/2014-ENVIRON-Report.pdf>
- ii. <https://fluorocouncil.com/wp-content/uploads/2017/08/2016-Ramboll-ENVIRON-Report.pdf>

Widely reviewed and approved by national and regional competent authorities. Commercially available and purchased for use at global level for over a decade.

## 14-2. Paper and packaging

### 1. FluoroCouncil

- **Fluorinated Alternatives**

Two alternative fluorinated technologies are in global use that provide oil- and grease repellent properties to paper and paper packaging.

These products have been evaluated by competent regulatory authorities responsible for their use in food contact paper and paper packaging. (e.g., Bundes Institut für Risikobewertung, BfR and the U.S. Food and Drug Administration, FDA)

Short-chain fluorotelomer-based side chain fluorinated polymers (aka “C6”). These are generally high molecular-weight acrylic polymers that contain 6:2 fluorotelomer functionality to provide the oil- and grease-repellent performance.

Examples of Suppliers who offer these products commercially and their websites:

- i. Daikin: <https://www.daikin.com/chm/products/fiber/index.html>
- ii. Asahi: <https://www.agc-chemicals.com/jp/en/fluorine/products/detail/use/index.html?pCode=JP-EN-F001>
- iii. Chemours: [https://www.chemours.com/Capstone/en\\_US/uses\\_apps/paper\\_packaging/index.html](https://www.chemours.com/Capstone/en_US/uses_apps/paper_packaging/index.html)
- iv. Archroma: <http://www.pp.archroma.com/surface-coating/cartaguard/>
- v. Fuxin Heng Tong Fluorine Chemicals Co. Ltd: <http://www.htfluor.us/>

Perfluoropolyether-based oil- and grease repellent products.

Supplier who offers these products commercially and their website:

- i. Solvay <https://www.solvay.com/en/markets-and-products/featured-products/solvera.html>

A description of these types of products may be found in this paper: Perfluoroalkyl and polyfluoroalkyl substances in the environment: Terminology, classification, and origins. Integrated Environmental Assessment and Management 2011, 7, (4), 513-541. <http://dx.doi.org/10.1002/ieam.258>

- **Not-in-kind Alternatives**

In addition, users requiring oil- and grease-proof packaging have widely shifted to not-in kind alternative packaging materials and systems (e.g., polymers/plastics for example in chocolate candy wrappers).

The alternatives described in Question 2 are widely purchased and have been in commercial use at a global level for several years. Have been on the market and extensively used as efficient alternatives for more than a decade. Available globally and approved by regulators. Short-chain alternatives have been adequately reviewed and approved by multiple competent regulatory authorities worldwide. Summaries of the environmental fate and health risk data associated with several key short-chain fluorotelomer substances can be found in the documents below:

- i. <https://fluorocouncil.com/wp-content/uploads/2017/08/2014-ENVIRON-Report.pdf>
- ii. <https://fluorocouncil.com/wp-content/uploads/2017/08/2016-Ramboll-ENVIRON-Report.pdf>

Widely reviewed and approved by national and regional competent authorities. Commercially available and purchased for use at global level for over a decade. Fact checker on food-contact: “The Facts about the Use of Fluorinated Chemicals in Food Packaging Materials”

- iii. <http://accfc.sachsdigital.com/wp-content/uploads/2017/06/Food-Packaging-Fact-Checker.pdf>

### 14-3. Coatings and coating additives

#### 1. FluoroCouncil

- Alternative fluorosurfactant technologies are in global use in Coatings as Coatings Additives.
- Short-chain fluorotelomer-based side chain fluorinated polymers (aka “C6”).

Examples of Suppliers who offer these products commercially and their websites:

- iv. Chemgard: <http://www.chemguard.com/specialty-chemicals/product-applications/wetting-leveling.htm>
- v. Chemours: [https://www.chemours.com/Capstone/en\\_US/uses\\_apps/fluorosurfactants/index.html](https://www.chemours.com/Capstone/en_US/uses_apps/fluorosurfactants/index.html)
- vi. Dynax: <http://dynaxcorp.com/>

- Short-chain electrochemical fluorination-based side chain fluorinated polymers (aka “C4”).

Examples of Suppliers who offer these products commercially and their websites:

- i. 3M: [http://solutions.3m.com/wps/portal/3M/en\\_EU/EU-EAMD/Home/OurProducts/NovecFluorosurfactants/](http://solutions.3m.com/wps/portal/3M/en_EU/EU-EAMD/Home/OurProducts/NovecFluorosurfactants/)
- ii. Miteni: <http://www.miteni.com/index.htm>

- Oxetane Fluorosurfactants

Example of a Supplier who offer these products commercially and their websites:

- i. Omnova Solutions: <https://www.omnova.com/product-types>

- FluoroCouncil reference to “one-pager”: <https://fluorocouncil.com/wp-content/uploads/2017/03/Building-applications-1.pdf> The alternatives described in Question 2 are widely purchased and have been in commercial use at a global level for several years.
- Have been on the market and extensively used as efficient alternatives for over a decade. Available globally and approved by regulators. Short-chain alternatives have been adequately reviewed and approved by multiple competent regulatory authorities worldwide. Summaries of the environmental fate and health risk data associated with several key short-chain fluorotelomer substances can be found in the documents below:

- i. <https://fluorocouncil.com/wp-content/uploads/2017/08/2014-ENVIRON-Report.pdf>
- ii. <https://fluorocouncil.com/wp-content/uploads/2017/08/2016-Ramboll-ENVIRON-Report.pdf>

- Summaries of the environmental fate and health risk data associated with several key short-chain fluorotelomer substances can be found in the documents below:
  - i. <https://fluorocouncil.com/wp-content/uploads/2017/08/2014-ENVIRON-Report.pdf>
  - ii. <https://fluorocouncil.com/wp-content/uploads/2017/08/2016-Ramboll-ENVIRON-Report.pdf>
- Widely reviewed and approved by national and regional competent authorities. Commercially available and purchased for use at global level for over a decade.

## 15. Open applications of PFOS

### 1. IPEN

- Open applications of PFOS release significant quantities of this extremely persistent substance and raise concerns about environmental and human exposure. The POPRC has engaged on this issue for many years. In 2011, in decision SC-5/5, COP5 requested the POPRC to develop a technical paper on the identification and assessment of alternatives to PFOS in open applications. The technical paper identified the following open applications of PFOS: aviation hydraulic fluids; firefighting foams; pesticides (insect baits for control of leaf-cutting ants from *Atta* spp. and *Acromyrmex* spp. and insecticides for control of red imported fire ants and termites); metal plating (hard metal plating and decorative plating); electric and electronic parts for some color printers and color copy machines; chemically driven oil production; carpets, leather, apparel, textiles and upholstery; paper and packaging; rubber and plastics; and coating and coating additives. These uses should be prioritized for phase-out due to their high potential for human and environmental exposure.

The “Technical paper on the identification and assessment of alternatives to the use of perfluorooctane sulfonic acid, its salts, perfluorooctane sulfonyl fluoride and their related chemicals in open applications” was used by the POPRC to develop recommendations on the alternatives to the use of PFOS in open applications for consideration by COP6. These recommendations included the following:

- (a) “Consider that information on the commercial availability and effectiveness of safer alternatives to PFOS, its salts, PFOSF and their related chemicals for the following applications has become available, and encourage parties to stop using PFOS, its salts, PFOSF and their related chemicals for these applications:
  - i. Fire-fighting foams;
  - ii. Insecticides for the control of red imported fire ants and termites;
  - iii. Decorative metal plating;
  - iv. Carpets;
  - v. Leather and apparel;
  - vi. Textiles and upholstery;

The POPRC encouraged Parties to restrict the use of PFOS in hard metal plating only to closed-loop systems and requested more information from Parties on uses of PFOS in aviation hydraulic fluids, chemically driven oil production, electric and electronic parts for some colour printers and colour copy machines. For sulfluramid, the POPRC recommended peer-reviewed studies and pilot projects to evaluate the feasibility of alternatives to PFOS within an integrated pest management approach.

Due to high concerns over PFOS use in open applications, in 2018 the POPRC should prioritize recommending the end of PFOS for uses in all open applications. In some cases, this may be accomplished by simply ending an acceptable purpose. In other cases, the POPRC could recommend converting an acceptable purpose into a specific exemption to provide a phase-out period. More details are provided below.

#### Specific exemptions

The specific exemptions for PFOS use in carpets, leather and apparel, textiles and upholstery, paper and packaging, coatings and coating additives, and rubber and plastics ended in August 2015 for all parties

except for two parties that accepted the amendments later and for which specific exemptions should end in 2016 (Canada) and 2019 (China). Note that no new registrations can be made for these uses after these dates.

The Stockholm Convention Registry of Exemptions indicates that the following Parties have either withdrawn their exemptions or they have expired so that they are no longer requested: Brazil, Canada, Czech Republic, EU, Iran, Nigeria, Switzerland, Turkey, and Vietnam.

China is the only Party with remaining specific exemptions on the Convention Registry for PFOS. The expiry date was not provided but registered exemptions include the following:

- i. Photo masks in semiconductor and LCD
- ii. Metal plating (hard metal plating)
- iii. Metal plating (decorative metal plating)
- iv. Electric and electronic parts for some colour printers and copy machines
- v. Insecticides for control of red imported fire ants and termites
- vi. Chemically driven oil production

Five of these specific exemptions are considered open applications and should be prioritized for withdrawal. All of these exemptions should expire in 2019 based on the accession date to this amendment by China. However, China may be ready to withdraw some or all of these exemptions sooner than 2019. Note that all of these uses were previously requested by one or more of the countries listed above and none of them requested an extension and some even withdrew exemptions. This indicates technically feasible alternatives have already been substituted for these uses – including in developing and transition countries.

### III. Compilation of information on PFOS, its salts and PFOSF

#### 1. Production of PFOS, its salts and PFOSF

Submitter	Information
Brazil and	There is no production of PFOS, its salts and PFOSF
Canada	PFOS was never produced in Canada.  The Prohibition of Certain Toxic Substances Regulations prohibit the import, manufacture, use, sale and offer for sale of PFOS, and products containing PFOS, with a limited number of exemptions.
Germany	Production of PFOS:  until 2015: 9 t/a  2016: none  CAS-No.: not recorded  Purpose: not recorded
Japan	Ban
UK	Tetraethylammonium heptadecafluorooctanesulphonate CAS RN: 56773-42-3 EC No.: 260-375-3  Full registration on REACH in tonnage band 0 - 10 tonnes per annum  The registration was first published in 2011 and last modified in 2017  No information was available on the purpose of the production, or any more detail than this.  There were three substances on the REACH pre-registration, these are as follows:  1-Octanesulfonic acid, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, branched, potassium salt CAS RN: 90480-49-2 EC No.: 291-784-5  1-Octanesulfonyl fluoride, 1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-heptadecafluoro-, branched CAS RN: 90480-50-5 EC No.: 291-785-0   (Z)-octadec-9-enyl [5-[[[2-[(perfluorooctyl)sulphonyl]methylamino] ethoxy]carbonyl]amino]-o-tolyl]carbamate  CAS RN: 94313-84-5 EC No.: 304-984-5  All three of these had “envisaged registration deadlines” of 31/05/2013  No other information on these were available.
ABRAISCA	No production in Brazil.
ZVO	None of the companies giving feedback has been producing PFOS, its salts or PFOSF

#### 2. Import of PFOS, its salts and PFOSF

Submitter	Information
Brazil	Perfluorooctane sulfonyl fluoride - PFOSF  CAS No: 307-35-7

	<p>Use: PFOSF as an intermediate in the production of sulfluramid to produce insect baits for control of leaf-cutting ants from <i>Atta spp.</i> and <i>Acromyrmex spp</i></p> <p>Country of import: CHINA</p> <table> <tr> <th>Year</th><th>Quantities KG</th></tr> <tr> <td>2013</td><td>50.000</td></tr> <tr> <td>2014</td><td>50.000</td></tr> <tr> <td>2015</td><td>47.267</td></tr> <tr> <td>2016</td><td>56.817</td></tr> <tr> <td>2017</td><td>63.760</td></tr> </table>	Year	Quantities KG	2013	50.000	2014	50.000	2015	47.267	2016	56.817	2017	63.760
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Canada	<p>Importation of PFOS, its salts and compounds that contain one of the following groups: C8F17SO2, C8F17SO3 or C8F17SO2N (PFOS) in Canada is prohibited by the Prohibition of Certain Toxic Substances Regulations, with a limited number of exemptions.</p> <p>The Regulations do not prohibit:</p> <ul style="list-style-type: none"> <li>• The import of PFOS or a product containing it, if PFOS is incidentally present</li> <li>• The import of PFOS or a product containing it if it is designed for use in photoresists or anti-reflective coatings for photolithography process or photographic films, papers and printing plates</li> <li>• The import of PFOS in aqueous film forming foam present in a military vessel or military fire-fighting vehicle contaminated during a foreign military operation</li> </ul> <p>Canada has no specific information on the quantity that could have been imported from the uses mentioned above.</p> <p>However, the World Semiconductor Council (WSC) announced in 2017 that the use of PFOS in semiconductor manufacturing had completely ceased.</p>												
Germany	None recorded.												
Japan	Ban												

Mexico	<p><i>PFOS and PFOA importations (Data from the Mexican Customs Office)</i></p> <table><tr><th>YEAR</th><th>PRODUCT IMPORTED</th><th>QUANTITY</th><th>UNIT</th><th>PFOS COMPOSITION [CAS NO. (% in weight)]</th><th>COUNTRY OF ORIGIN</th></tr><tr><td>2010</td><td>FT-248</td><td>75</td><td>Kg</td><td>56773-42-3 (45%)</td><td>China</td></tr><tr><td rowspan="2">2011</td><td>FC-95 &amp; FT-830</td><td>35</td><td>Kg</td><td>2795-39-3, 3872-25-1 (Unknown)</td><td>China</td></tr><tr><td>FT-248</td><td>100</td><td>Kg</td><td>56773-42-3 (45%)</td><td>China</td></tr><tr><td rowspan="6">2012</td><td>Perfluorooctanesulfonic acid</td><td>150</td><td>Kg</td><td>1763-23-1 (Unknown)</td><td>Germany</td></tr><tr><td>FC-95</td><td>100</td><td>Kg</td><td>2795-39-3 (82-86%)-3872-25-1 (1-3%)</td><td>China</td></tr><tr><td>FT-248</td><td>1525</td><td>Kg</td><td>56773-42-3 (45%)</td><td>China (700 Kg), Germany (825 Kg)</td></tr><tr><td>FUMETROL 140</td><td>1241</td><td>Kg</td><td>754-91-6 (&lt;7%)</td><td>USA</td></tr><tr><td>Potassium heptadecafluorooctane sulfate</td><td>0.92</td><td>Kg</td><td>2795-39-3 (Unknown)</td><td>Japan</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="3">2013</td><td>FC-95</td><td>50</td><td>Kg</td><td>2795-39-3 (82-86%)-3872-25-1 (1-3%)</td><td>China</td></tr><tr><td>FT-248</td><td>600</td><td>Kg</td><td>56773-42-3 (45%)</td><td>China</td></tr><tr><td>FUMETROL 140</td><td>1046</td><td>Kg</td><td>754-91-6 (&lt;7%)</td><td>USA</td></tr><tr><td rowspan="4">2014</td><td>Perfluorooctanoic acid in methanol (PFOA)</td><td>0.38</td><td>Kg</td><td>335-67-1 (Unknown)</td><td>USA</td></tr><tr><td>FC-95</td><td>50</td><td>Kg</td><td>2795-39-3 (82-86%)-3872-25-1 (1-3%)</td><td>China</td></tr><tr><td>FT-248</td><td>400</td><td>Kg</td><td>56773-42-3 (45%)</td><td>China</td></tr><tr><td>FUMETROL 140</td><td>1020</td><td>Kg</td><td>754-91-6 (&lt;7%)</td><td>USA (1878.8 Kg), Canada (41.2 Kg)</td></tr><tr><td rowspan="5">2015</td><td>Heptadecafluorooctanesulfonic acid</td><td>0.91</td><td>Kg</td><td>1763-23-1 (Unknown)</td><td>India</td></tr><tr><td>FC-95</td><td>50</td><td>Kg</td><td>2795-39-3 (82-86%)-3872-25-1 (1-3%)</td><td>China</td></tr><tr><td>FT-248</td><td>200</td><td>Kg</td><td>56773-42-3 (45%)</td><td>China</td></tr><tr><td>FUMETROL 140</td><td>1542.66</td><td>Kg</td><td>754-91-6 (&lt;7%)</td><td>USA</td></tr><tr><td>Potassium heptadecafluorooctane sulfate</td><td>0.91</td><td>Kg</td><td>2795-39-3 (Unknown)</td><td>USA</td></tr></table> <table><tr><th>CAS NO.</th><th>CHEMICAL NAME</th></tr><tr><td>1763-23-1</td><td>Perfluorooctane sulfonic acid (PFOS)</td></tr><tr><td>2795-39-3</td><td>Potassium perfluorooctane sulfonate</td></tr><tr><td>335-67-1</td><td>Perfluorooctanoic acid (PFOA)</td></tr><tr><td>3872-25-1</td><td>Potassium perfluoropentanesulfonate</td></tr><tr><td>56773-42-3</td><td>Tetraethylammonium perfluorooctane sulfonate</td></tr><tr><td>754-91-6</td><td>Perfluorooctanesulfonamide</td></tr></table>	YEAR	PRODUCT IMPORTED	QUANTITY	UNIT	PFOS COMPOSITION [CAS NO. (% in weight)]	COUNTRY OF ORIGIN	2010	FT-248	75	Kg	56773-42-3 (45%)	China	2011	FC-95 & FT-830	35	Kg	2795-39-3, 3872-25-1 (Unknown)	China	FT-248	100	Kg	56773-42-3 (45%)	China	2012	Perfluorooctanesulfonic acid	150	Kg	1763-23-1 (Unknown)	Germany	FC-95	100	Kg	2795-39-3 (82-86%)-3872-25-1 (1-3%)	China	FT-248	1525	Kg	56773-42-3 (45%)	China (700 Kg), Germany (825 Kg)	FUMETROL 140	1241	Kg	754-91-6 (<7%)	USA	Potassium heptadecafluorooctane sulfate	0.92	Kg	2795-39-3 (Unknown)	Japan						2013	FC-95	50	Kg	2795-39-3 (82-86%)-3872-25-1 (1-3%)	China	FT-248	600	Kg	56773-42-3 (45%)	China	FUMETROL 140	1046	Kg	754-91-6 (<7%)	USA	2014	Perfluorooctanoic acid in methanol (PFOA)	0.38	Kg	335-67-1 (Unknown)	USA	FC-95	50	Kg	2795-39-3 (82-86%)-3872-25-1 (1-3%)	China	FT-248	400	Kg	56773-42-3 (45%)	China	FUMETROL 140	1020	Kg	754-91-6 (<7%)	USA (1878.8 Kg), Canada (41.2 Kg)	2015	Heptadecafluorooctanesulfonic acid	0.91	Kg	1763-23-1 (Unknown)	India	FC-95	50	Kg	2795-39-3 (82-86%)-3872-25-1 (1-3%)	China	FT-248	200	Kg	56773-42-3 (45%)	China	FUMETROL 140	1542.66	Kg	754-91-6 (<7%)	USA	Potassium heptadecafluorooctane sulfate	0.91	Kg	2795-39-3 (Unknown)	USA	CAS NO.	CHEMICAL NAME	1763-23-1	Perfluorooctane sulfonic acid (PFOS)	2795-39-3	Potassium perfluorooctane sulfonate	335-67-1	Perfluorooctanoic acid (PFOA)	3872-25-1	Potassium perfluoropentanesulfonate	56773-42-3	Tetraethylammonium perfluorooctane sulfonate	754-91-6	Perfluorooctanesulfonamide
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UK	<p>Information supplied by HM Revenue &amp; Customs indicates that in 2017 the UK arrived (imported) 2 kg of perfluorooctane sulphonic acid (PFOS) from Germany and 99,300 kg from Italy.</p> <p>The purpose was unspecified.</p>																																																																																																																																			
ABRAISCA	<p>Perfluorooctane sulfonyl fluoride - PFOSF</p> <p>CAS No: 307-35-7</p> <p>Use: PFOSF as an intermediate in the production of sulfluramid to produce insect baits for control of leaf-cutting ants from <i>Atta spp.</i> and <i>Acromyrmex spp</i></p> <p>Country of import: CHINA</p> <table><tr><th>Year</th><th>Quantities KG</th></tr><tr><td></td><td></td></tr></table>	Year	Quantities KG																																																																																																																																	
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	2013	43.460	
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	2015	43.042	
	2016	54.633	
	2017	53.519	

### 3. Export of PFOS, its salts and PFOSF

Submitter	Information
Brazil	There is no export of PFOS, its salts and PFOSF
Canada	<p>Since 2012, the Export of Substances on the Export Control List Regulations establish restrictions on the exports of perfluorooctane sulfonates, perfluorooctane sulfonamides and perfluorooctane sulfonyls, which are listed on Part 2 of the Export Control List (ECL). A prior notification of export is required for all exports of substances listed on the ECL.</p> <p>No notification of any export of Perfluorooctane sulfonates, perfluorooctane sulfonamides and perfluorooctane sulfonyls have been received, therefore the quantity exported from Canada is 0 kg.</p>
Germany	<p>PFOS, CAS-No. not recorded</p> <p>2013:</p> <p>Export 5767 kg:</p> <p>Australia 100.000 kg</p> <p>Brazil 390.100 kg</p> <p>Hong Kong 225.000 kg</p> <p>India 25.100 kg</p> <p>Republic South Korea 1,576.600 kg</p> <p>Singapore 150.000 kg</p> <p>South Africa 350.000 kg</p> <p>Switzerland 0.200 kg</p> <p>Taiwan 250.000 kg</p> <p>Thailand 0.100 kg</p> <p>Turkey 700.000 kg</p> <p>USA 2,000.100 kg</p> <p>2014:</p> <p>PFOS: Export 2359 kg:</p> <p>Australia 50 kg</p> <p>Bosnia and Herzegovina 3 kg</p> <p>Brazil 675 kg</p> <p>Hong Kong 25 kg</p> <p>India 13 kg</p> <p>Korea, Republic of 188 kg</p> <p>Singapore 25 kg</p> <p>South Africa 192 kg</p> <p>Taiwan 300 kg</p> <p>Turkey 175 kg</p> <p>United States 713 kg</p> <p>2015:</p> <p>None</p>

	2016: Export of tetraethylammonium heptadecafluorooctanesulphonate, CAS-No. 56773-42-3: Australia 62.5 kg Brasilia 787.5 kg Switzerland 25.0 kg Hongkong 25.0 kg South Korea 175.0 kg Turkey 225.0 kg South Africa 125.0 kg
Japan	Salts of perfluoro(octane-1-sulfonic acid)(CAS:1763-23-1)  Exported to Taiwan as resist materials for semiconductors in FY2010. Exported amount is 2.058Kg (content in resist material)
UK	Information supplied by HM Revenue & Customs indicates that in 2017 the UK has dispatched (exported) 30 kg of perfluorooctane sulphonic acid (PFOS) to Spain.  The purpose was unspecified.
ABRAISCA	No export of PFOSF

#### 4. Use of PFOS, its salts and PFOSF

Submitter	Information												
Brazil	<p>Perfluorooctane sulfonyl fluoride - PFOSF</p> <p>CAS No: 307-35-7</p> <p>Use: PFOSF as an intermediate in the production of sulfluramid to produce insect baits for control of leaf-cutting ants from <i>Atta spp.</i> and <i>Acromyrmex spp</i></p> <table border="1"> <thead> <tr> <th>Year</th><th>Quantities KG</th></tr> </thead> <tbody> <tr> <td>2013</td><td>45.894</td></tr> <tr> <td>2014</td><td>49.019</td></tr> <tr> <td>2015</td><td>47.267</td></tr> <tr> <td>2016</td><td>56.817</td></tr> <tr> <td>2017</td><td>56.144</td></tr> </tbody> </table>	Year	Quantities KG	2013	45.894	2014	49.019	2015	47.267	2016	56.817	2017	56.144
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	<ul style="list-style-type: none"> <li>• The use of manufactured items containing PFOS if they were manufactured or imported before May 29, 2008</li> </ul> <p>Canada has no specific information on the quantity that could have been used from the uses mentioned above.</p> <p>Globally, it is also expected that the use of PFOS in the photographic sector is declining rapidly as users move further towards digital imaging.</p> <p>AFFF containing PFOS have not been manufactured in the U.S. or Europe since 2002. The major suppliers of AFFF in Canada were recently interviewed and they all indicated they no longer use C8 fluorosurfactants in their production process. It is estimated that these manufacturers have 90-100% of the firefighting foam market in Canada.</p>
Germany	<p>The EU restriction is not limited to PFOS, its salts and PFOS-F but covers all PFOS derivatives defined as C8F17SO2X, X= OH, metal salt (O-M+), halide, amide, and other derivatives including polymers.</p> <p>The EU has registered for the following acceptable purposes and specific exemptions:</p> <p>Acceptable purposes:</p> <ul style="list-style-type: none"> <li>• Photo-imaging;</li> <li>• Photo-resist and anti-reflective coatings for semi-conductors;</li> <li>• Etching agent for compound semi-conductors and ceramic filters;</li> <li>• Metal plating (hard metal plating) only in closed-loop systems.</li> </ul> <p>The EU has withdrawn its notification for the production and use of aviation hydraulic fluids on 09/06/2017.</p> <p>Specific exemptions:</p> <p>The specific exemption for metal plating (hard metal plating) has expired on 26/08/2015</p> <p>The quantities used are not recorded per purpose in Germany.</p>
Japan	<p>1.Salts of perfluoro(octane-1-sulfonic acid)</p> <p>Used 2.652Kg for manufacturing resist materials in FY2010.</p> <p>2.Ammonium salt of perfluoro(octane-1-sulfonic acid)</p> <p>Used 13Kg in FY2010 and 0.5Kg in FY2011 for manufacturing etching agents.</p>
UK	<p>We have collated the last three years' worth of stockpile notifications for PFOS.</p> <p>2015 (total 131 kg):</p> <p>Perfluorooctane Sulphonate (CAS RN 56773-42-3) 1.25 kg Spray Suppressant for chrome plating solution</p> <p>Perfluorooctane Sulphonate (CAS RN 56773-42-3) 1.2 kg Chromic Anodising Solution containing 0.4% Spray Suppressant</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 0.125 kg Wetting agent</p> <p>Perfluorooctane Sulphonate (CAS RN: 56773-42-3) 0.0834 kg Wetting agent</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 30 kg Raw material for the manufacture of proprietary products for mist suppression in hard chromium plating solutions and as wetting agents in controlled electroplating systems.</p>

	<p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 25 kg Raw material for the manufacture of proprietary products for mist suppression in hard chromium plating solutions and as wetting agents in controlled electroplating systems.</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 69.96 kg Stocks of blended proprietary product for sale to customers who will use them as spray suppressants for hard chromium plating or as wetting agents in plating on plastics processes.</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 0.06 kg Small scale demonstration tanks for exempted processes.</p> <p>Perfluorooctane Sulphonate (CAS RN: 56773-42-3) 0.75 kg Used as a spray suppressant for chromic acid mist arising from metal finishing. Chemical solution contains 1-5% PFOS, and is diluted for use at 0.8ml/l in 7000 litres of chromic acid. We are in the transition phase of moving to a substitute chemical that does not contain PFOS - hence no neat stock quantities are held.</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 0.05 kg Wetting agent</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 2.085 kg Wetting agent</p> <p>2016 (total 62 kg):</p> <p>Perfluorooctane Sulphonate (CAS RN: 56773-42-3) 1.25 kg Spray Suppressant for Chromic Anodising Process</p> <p>Perfluorooctane Sulphonate (CAS RN: 56773-42-3) 1.2 kg Chromic Anodising Solution containing 0.4% Spray Suppressant</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 15 kg Raw material for the manufacture of proprietary products for mist suppression in hard chromium plating solutions.</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 15 kg Raw material for the manufacture of proprietary products for mist suppression in hard chromium plating solutions.</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 29.15 kg Stocks of blended proprietary product for sale to customers who will use them as spray suppressants for hard chromium plating.</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 0.03 kg Small scale demonstration tanks for exempted process (hard chromium plating).</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) Retained volume within plating solution. This is reducing as it is no longer being replenished as PFOS based product for maintaining surface tension no longer available for decorative chromium plating.</p> <p>2017 (total 120.23 kg):</p> <p>PFOS (CAS RN: n/a) 48.6 kg PFOS is added to our chromic acid plating tanks as a mist suppressant. Our system is closed loop. Waste routes are clearly defined and concentrations are below any actionable level.</p> <p>Perfluorooctane Sulphonate (CAS RN: 56773-42-3) 1.25 kg Spray Suppressant for Chromic Anodising Process</p> <p>Perfluorooctane Sulphonate (CAS RN: 56773-42-3) 1.2 kg Chromic Anodising Solution containing 0.4% Spray Suppressant</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 15 kg Raw material for the manufacture of proprietary products for mist</p>
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	<p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 25 kg Raw material for the manufacture of proprietary products for mist</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 29.15 kg Stocks of blended proprietary product for sale to customers who will use them as spray suppressants for hard chromium plating.</p> <p>Tetraethylammonium perfluorooctane sulphonate (CAS RN: 56773-42-3) 0.03 kg Small scale demonstration tanks for exempted process (hard chromium plating).</p>												
ABRAISCA	<p>Perfluorooctane sulfonyl fluoride - PFOSF</p> <p>CAS No: 307-35-7</p> <p>Use: PFOSF as an intermediate in the production of sulfluramid to produce insect baits for control of leaf-cutting ants from <i>Atta spp.</i> and <i>Acromyrmex spp</i></p> <table border="1"> <thead> <tr> <th>Year</th><th>Quantities KG</th></tr> </thead> <tbody> <tr> <td>2013</td><td>43.460</td></tr> <tr> <td>2014</td><td>47.444</td></tr> <tr> <td>2015</td><td>43.042</td></tr> <tr> <td>2016</td><td>54.633</td></tr> <tr> <td>2017</td><td>53.519</td></tr> </tbody> </table>	Year	Quantities KG	2013	43.460	2014	47.444	2015	43.042	2016	54.633	2017	53.519
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2013	43.460												
2014	47.444												
2015	43.042												
2016	54.633												
2017	53.519												
ZVO	Just one company reported a remaining use of about 5l/a. No other company giving feedback uses PFOS, its salts or PFOSF												

## 5. Continued need for acceptable purposes and specific exemptions

Submitter	Information
Brazil	<p>Yes acceptable purpose of PFOSF as an intermediate in the production of sulfluramid to produce insect baits for control of leaf-cutting ants from <i>Atta spp.</i> and <i>Acromyrmex spp</i></p> <p>The insect baits with sulfluramid for control of leaf-cutting ants is indispensable for the Brazilian Agriculture. The leaf-cutting ants of the genus <i>Atta spp.</i> and <i>Acromyrmex spp.</i> are among the most important plagues of the Brazilian agriculture, because their voracious attacks occur throughout the year and are spread to the entire country. The damages are immense, bringing losses to large and small crops, fruit and vegetable cultures, pastures, reforestation, etc.</p> <p>Sulfluramid is, among the active ingredients, the best one with all features necessary for the good operation as an ant bait, which places it as the single efficient option to control leaf-cutting ants, taking into account technical feasibility, humans and environment effects, cost/effectiveness, availability and viability.</p> <p>Currently, the active ingredients registered in Brazil for ant baits are sulfluramid, fipronil and chlorpyrifos. Chlorpyrifos as insect baits is no longer used in Brazil for control leaf cutting ants. According to the Brazilian Annex F information, sulfluramid cannot currently be efficiently replaced in Brazil by any other registered products commercialized since these alternatives have been questioned concerning their efficiency.</p> <p>(UNEP/POPS/POPRC.12/INF/15/Rev.1)</p>

Canada	<p>Canada supports evaluating the progress that Parties have made towards achieving the ultimate objective of elimination of PFOS and to review the continued need for the specific exemptions and acceptable purposes.</p> <p>Canada has prohibited all specific exemptions and many of the acceptable purposes.</p> <p>As such, Canada can support the removal of all specific exemptions and a number of acceptable purposes.</p>
Japan	<p>Plan to cancel specific exemptions in domestic laws in April 2018 because substitution is completed for the use of photo-imaging, photo-resistant, anti-reflective coatings for semi-conductors, etching agent for compound semi-conductors and ceramic filters, and certain medical devices which are registered as acceptable purposes.</p>
Poland	<p>Poland has not registered individually for acceptable purposes. However EU has registered for acceptable purpose related to production and use:</p> <ul style="list-style-type: none"> <li>- Photo-imaging;</li> <li>- Photo-resist and anti-reflective coatings for semi-conductors;</li> <li>- Etching agent for compound semi-conductors and ceramic filters;</li> <li>- Aviation hydraulic fluids (withdrawn on 09/06/2017);</li> <li>- Metal plating (hard metal plating) only in closed-loop systems.</li> </ul> <p>The EU restriction is not limited to PFOS, its salts and PFOSF but covers all PFOS derivatives defined as C8F17SO2X</p> <p>X= OH, metal salt (O-M+), halide, amide, and other derivatives including polymers.</p> <p>The fire-fighting foams that were placed on the EU market before 27 December 2006 could be used till 27 June 2011.</p> <p>The review of the continued need for those purposes is sustained and takes place on EU level.</p>
UK	<p>We requested information from companies and trade associations but did not receive any responses.</p>
ABRAISCA	<p>Annex B as acceptable purpose for the use PFOSF as an intermediate in the production of sulfluramid, for the production of insect baits for control of leaf-cutting ants from Atta spp and Acromyrmex spp. (Descision SC-4/17).</p> <p>Sulfluramid is used in Brazil and Latin America as active ingredient in the manufacturing of ant baits for the control of leaf-cutting ants from the genus Atta spp. and Acromyrmex spp., which are insects that cause the most damages to agriculture.</p> <p>According to the Brazilian delegation, the use of sulfluramid in Brazil prevents damage corresponding to losses of up to 14.5 % of trees per hectare. Other agricultural products likely to suffer costly losses are soybean and maize. In addition, the per-hectare capacity to support livestock is likely to decrease if forage for grazing is reduced by ants.</p> <p>According to the Brazilian Annex F information, sulfluramid cannot currently be efficiently replaced in Brazil by any other registered products commercialized for the same purpose. Sulfluramid is the only active ingredient with all the properties necessary for effective functioning as insect bait, which makes it the only effective option for controlling leaf-cutting ants.</p> <p>(UNEP/POPS/POPRC.12/INF/15/Rev.1)</p>
Galvano Röhrig GmbH	<p>We do not use PFOS, its salts or PFOFS right now. We would use PFOS again if its possible to use it in a closed system, approved by law.</p>

## 6. Progress in eliminating PFOS, its salts and PFOSF

Submitter	Information
Brazil	The production of sulfluramid is made from PFOSF. Researches are being conduct to identify alternatives, but at the moment sulfluramid can not be replaced in Brazil.
Canada	<p>Canada has prohibited all specific exemptions and many of the acceptable purposes.</p> <p>Since 2008, PFOS has been restricted in Canada through the Perfluorooctane Sulfonate and its Salts and Other Compounds Regulations, with a limited number of exemptions.</p> <p>In 2016, PFOS was added to the Prohibition of Certain Toxic Substances Regulations, 2012. These regulations include more limited exemptions than the previous regulations.</p>
Germany	The EU has withdrawn its notification for the production and use of aviation hydraulic fluids on 09/06/2017, the withdrawal of the notifications for use of PFOS as etching agent for compound semi-conductors and ceramic filters as well as in photo-imaging was announced to follow soon.
Japan	Banned to manufacture PFOS except for the use of research and development. Plan to ban also to use in April 2018.
UK	<p><b>Communications</b></p> <p>The Environment Agency encouraged Fire and Rescue Services to move away from PFOS-containing foams, before it became a legal requirement. This was done via guidance in a Communities and Local Government Circular released in July 2006 (Ref 40/2006). However, there had been no further communication on the subject and no co-ordinated communications to those industry sectors whose operators could hold their own foam stocks for use in case of fire incidents.</p> <p><b>Briefings</b></p> <p>A briefing note about the required phase-out and necessary actions was circulated:</p> <ul style="list-style-type: none"> <li>• Sent directly to permitted sites via their Environment Agency inspector.</li> <li>• Uploaded to the Communities of Practice forum for Pollution Prevention Control staff at local authorities.</li> <li>• Shared with Health Safety Executive's (HSE's) COMAH (Control of Major Accident Hazards) business support unit.</li> <li>• Emailed to a number of relevant trade associations for onward cascade to their members.</li> <li>• Sent for inclusion in the Energy Institute's revised Code of Practice.</li> <li>• Uploaded to the PFOS webpage on the Environment Agency's external website.</li> </ul> <p><b>Other external communications</b></p> <p>Three articles were published in relevant trade journals.</p> <ul style="list-style-type: none"> <li>• Article and later update published in JOIFF's month publication – The Catalyst magazine (January 2011, follow-up in July 2011).</li> <li>• Feature article (interview) published in the Industrial Fire Journal (IFJ Q3, 2011).</li> <li>• A presentation was also delivered to the Humber Chemical Forum (Fire &amp; Security Group) meeting.</li> </ul> <p><b>Outcomes</b></p> <p>There is no direct requirement to notify the Environment Agency when PFOS foams are being disposed of; however, the campaign has led to disposal information being submitted to the CCT</p>

	via enquiries. To date, approximately 27,000 litres of PFOS contaminated material (foams and contaminated system wash water) has been sent for disposal by hazardous waste incineration.
ABRAISCA	It's not possible to produce sulfluramid without PFOSF, and until now there is no alternatives for replacement.
Galvano Röhrig GmbH	Antifog CR ist als Alternative im Einsatz. Antifog CR is in use as alternative. Lieferant (supplier): Chemisol GmbH & Co. KG Arnzhäuschen 36 42929 Wermelskirchen Deutschland
ZVO	The companies giving feedback do not use the substances anymore.

## 7. Progress in building the capacity of countries to transfer safely to reliance on alternatives

Submitter	Information
Canada	<p>Canada has been an active contributor through several POPRC and COP intersessional work items and has participated in the development of several documents in relation to PFOS including the Guidance on alternatives to perfluorooctane sulfonic acid and its salts, perfluorooctane sulfonyl fluoride and their related chemicals.</p> <p>Canada has an expert on the best available techniques and best environmental practices (BAT/BEP) committee. This expert group recently developed guidance on BAT/BEP for the use of PFOS and related chemicals listed under the Stockholm Convention.</p> <p>Canada is also part of the OECD/UNEP Global Perfluorinated Chemicals (PFC) Group which manage the OECD Portal on per and poly-fluorinated chemicals. This portal focuses specifically on per- and polyfluoroalkyl substances (including PFOS) in order to support a global transition towards safer alternatives.</p> <p><a href="http://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/alternatives/">http://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/alternatives/</a></p>
Germany	Germany has informed delegations from abroad on its efforts in phasing out PFOS, and the alternatives and alternative processes used in Germany.
Galvano Röhrig GmbH	The alternative is in use since 2008. There are still traces of PFOS detectable (at the nanoscale). These traces are far below the allowed threshold value.
ZVO	PFOS, its salts and PFOF are no longer used. In most cases other multi- or polyfluorinated surfactants are used in surface treatment

## 8. Research/development of safe alternatives

Submitter	Information
Brazil	Brazil presented a peer-reviewed study "Review, analysis and discussion on the feasibility of the use of alternatives to PFOS, its salts, and PFOSF for the control of leaf-cutting ants <i>Atta</i> and <i>Acromyrmex</i> within the integrated pest management approach" UNEP-POPS-POPRC11-FU-SUBM-PFOS-BRAZIL-3-20160108.En, and the conclusion of this study is that chemical control with toxic baits is still the only one that has technology available to control leaf-cutting ants genus <i>Atta</i> spp and <i>Acromyrmex</i> spp with technical, economic and operational viability and that sulfluramid is among the active ingredients currently registered in Brazil, the only one who has all the characteristics necessary to proper functioning of a toxic bait, which places it as the only effective option to control leaf-cutting ants. (UNEP/POPS/POPRC.12/INF/15/Rev.1)
Canada	<p>Canada has prohibited all specific exemptions and many of the acceptable purposes.</p> <p>Alternatives to PFOS substances that are not on the Domestic Substances List are subject to the <i>New Substances Notification Regulations</i> under the <i>Canadian Environmental Protection Act, 1999</i> (CEPA 1999). These Regulations were created to ensure that no new substances are</p>

	<p>introduced into the Canadian marketplace before an assessment of whether they are potentially toxic has been completed and any appropriate or required control measures have been taken.</p> <p>Alternatives to PFOS have already been developed for the majority of uses as a result of the phase-out in production by the major manufacturer between 2000 and 2002. Significant global effort is already being put into the development of alternatives.</p> <p>Canada has been an active contributor through several POPRC and COP intersessional work items and participated in the development of several document in relation to PFOS including the Guidance on alternatives to perfluorooctane sulfonic acid and its salts, perfluorooctane sulfonyl fluoride and their related chemicals.</p> <p>Canada is also part of the OECD/UNEP Global Perfluorinated Chemicals (PFC) Group which manage the OECD Portal on per and poly-fluorinated chemicals. This portal focuses specifically on per- and polyfluoroalkyl substances (including PFOS) in order to support a global transition towards safer alternatives.</p> <p><a href="http://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/alternatives/">http://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/alternatives/</a></p>
UK	<p>A number of companies have provided information on alternatives to PFOS that they have moved on to. These include:</p> <p>MACUPLEX STR NPFX mist controller/surface tension reducer supplied by MacDermid Enthone. The product is described as a unique and complex mixture of anionic fluorinated surfactants.</p> <p>ANKOR® Dyne 30 MS is a foamless, PFOS-free chrome mist suppressant. Produced by enthrone® an Alent plc Company.</p>
ABRAISCA	<p>According to the submission from Brazil peer-reviewed study “Review, analysis and discussion on the feasibility of the use of alternatives to PFOS, its salts, and PFOSF for the control of leaf-cutting ants Atta and Acromyrmex within the integrated pest management approach” set out in the document UNEP-POPS-POPRC11-FU-SUBM-PFOS-BRAZIL-3-20160108.En, there are no alternatives for replacement of sulfluramid to the control of leaf-cutting ants genus atta spp. and acromyrmex spp. taking into account technical feasibility, humans and environment effects, cost/effectiveness, availability and viability.</p> <p>Sulfluramid is among the active ingredients currently registered in Brazil, the only one who has all the characteristics necessary to proper functioning of a toxic bait, which places it as the only effective option to control leaf-cutting ants.</p> <p>UNEP/POPS/POPRC.12/INF/15/Rev.1</p> <p>UNEP-POPS-POPRC11-FU-SUBM-PFOS-BRAZIL-3-20160108.En</p>
Galvano Röhrig GmbH	<p>Antifog CR is a safe alternative for the decorative plating process. The measured workplace concentrations are far below the allowed threshold value.</p>
ZVO	<p>Many other multi- or polyfluorinated have substituted PFOS, its salts and PFOSF. Additionally there have been trials with nonfluorinated substances; but they show significant drawbacks.</p>

## IV. Compilation of information on sulfluramid

### 1. Brazil

<b>1. Production of sulfluramid</b>  Please specify the purpose of the production and the years in which the chemicals were produced.  Please provide the quantities in kg/year.	Production of sulfluramid from PFOSF for the production of insect baits for control of leaf-cutting ants from <i>Atta spp</i> and <i>Acromyrrmex spp</i>  2013- 28.684 kg  2014- 30.637 kg  2015- 29.542 kg  2016- 35.511 kg  2017- 35.090 kg																																																																																																
<b>2. Import of sulfluramid</b>  Please specify the purpose of the import, the countries from which the chemicals were imported and the years in which the chemicals were imported.  Please provide the quantities in kg/year.	There is no import of sufluramid																																																																																																
<b>3. Export of sulfluramid</b>  Please specify the purpose of the export, countries to which the chemicals were exported and the years in which the chemicals were exported.  Please provide the quantities in kg/year.	<div>Export of insect bait for control of leaf-cutting ants containing sulfluramid (0,3%)  <i>Follow the amount of sulfluramid corresponding 0,3% of active ingredient containing in the insect bait.</i></div> <table><tr><th>Country</th><th colspan="5">Amount in metric kg of <u>SULFLURAMID</u> export</th></tr><tr><th></th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th></tr><tr><td>Bolivia</td><td>30</td><td>45</td><td>45</td><td>127,20</td><td>33,75</td></tr><tr><td>Colombia</td><td>216</td><td>324</td><td>102</td><td>114</td><td>276,75</td></tr><tr><td>Costa Rica</td><td>129,78</td><td>95,25</td><td>90</td><td>135</td><td>90,03</td></tr><tr><td>Ecuador</td><td>246</td><td>285</td><td>216</td><td>339,03</td><td>285,03</td></tr><tr><td>El Salvador</td><td></td><td>30</td><td>30</td><td>36</td><td>36</td></tr><tr><td>Guatemala</td><td>72</td><td>87</td><td>96</td><td>96</td><td>96</td></tr><tr><td>Honduras</td><td>63</td><td>105</td><td>105</td><td>63</td><td>63</td></tr><tr><td>Nicaragua</td><td></td><td></td><td></td><td>60</td><td>30</td></tr><tr><td>Panama</td><td>51</td><td>90</td><td>90</td><td>90</td><td>135</td></tr><tr><td>Paraguay</td><td>15</td><td></td><td>9</td><td>9</td><td>18</td></tr><tr><td>Peru</td><td>36</td><td></td><td></td><td>21</td><td></td></tr><tr><td>Suriname</td><td></td><td>27</td><td></td><td></td><td></td></tr><tr><td>Uruguay</td><td>0,09</td><td>15</td><td></td><td></td><td></td></tr><tr><td><b>Total</b></td><td><b>858,87</b></td><td><b>1.103,25</b></td><td><b>783,00</b></td><td><b>1.090,23</b></td><td><b>1.063,56</b></td></tr></table>	Country	Amount in metric kg of <u>SULFLURAMID</u> export						2013	2014	2015	2016	2017	Bolivia	30	45	45	127,20	33,75	Colombia	216	324	102	114	276,75	Costa Rica	129,78	95,25	90	135	90,03	Ecuador	246	285	216	339,03	285,03	El Salvador		30	30	36	36	Guatemala	72	87	96	96	96	Honduras	63	105	105	63	63	Nicaragua				60	30	Panama	51	90	90	90	135	Paraguay	15		9	9	18	Peru	36			21		Suriname		27				Uruguay	0,09	15				<b>Total</b>	<b>858,87</b>	<b>1.103,25</b>	<b>783,00</b>	<b>1.090,23</b>	<b>1.063,56</b>
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	<p><b>Note 1:</b> the table above is indicating the amount of sulfluramid corresponding to 0,3% of active ingredient.</p> <p><b>Nota 2:</b> Brasil exported Sulfuramid (Technical product – 93%) to Argentina</p> <p>2013- 660 kg – equivalent to 613,8 kg of Sulfluramid</p> <p>2014- 840 kg - equivalent to 781,2 kg of Sulfluramid</p> <p>2015- 690 kg - equivalent to 741,9 kg of Sulfluramid</p> <p>2016- 1.020 kg - equivalent to 948,6 kg of Sulfluramid</p> <p>2017- 840 kg - equivalent to 781,2 kg of Sulfluramid</p> <table><tr><th>Country</th><th colspan="5">Amount in metric kg of <u>INSECT BAIT (0,3% ai) export</u></th></tr><tr><th></th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th></tr><tr><td>Bolivia</td><td>10.000</td><td>15.000</td><td>15.000</td><td>42.400</td><td>11.250</td></tr><tr><td>Colombia</td><td>72.000</td><td>108.000</td><td>34.000</td><td>38.000</td><td>92.250</td></tr><tr><td>Costa Rica</td><td>43.260</td><td>31.750</td><td>30.000</td><td>45.000</td><td>30.010</td></tr><tr><td>Ecuador</td><td>82.000</td><td>95.000</td><td>72.000</td><td>113.010</td><td>95.010</td></tr><tr><td>El Salvador</td><td></td><td>10.000</td><td>10.000</td><td>12.000</td><td>12.000</td></tr><tr><td>Guatemala</td><td>24.000</td><td>29.000</td><td>32.000</td><td>32.000</td><td>32.000</td></tr><tr><td>Honduras</td><td>21.000</td><td>35.000</td><td>35.000</td><td>21.000</td><td>21.000</td></tr><tr><td>Nicaragua</td><td></td><td></td><td></td><td>20.000</td><td>10.000</td></tr><tr><td>Panama</td><td>17.000</td><td>30.000</td><td>30.000</td><td>30.000</td><td>45.000</td></tr><tr><td>Paraguay</td><td>5.000</td><td></td><td>3.000</td><td>3.000</td><td>6.000</td></tr><tr><td>Peru</td><td>12.000</td><td></td><td></td><td>7.000</td><td></td></tr><tr><td>Suriname</td><td></td><td>9.000</td><td></td><td></td><td></td></tr><tr><td>Uruguay</td><td>30</td><td>5.000</td><td></td><td></td><td></td></tr><tr><td><b>Total</b></td><td><b>286.290</b></td><td><b>367.750</b></td><td><b>261.000</b></td><td><b>363.410</b></td><td><b>354.520</b></td></tr></table> <p><b>Note 3:</b> The table above correspond of insect bait as final product (orange pulp + vegetable oil + sulfluramid), indicate in kg.</p>	Country	Amount in metric kg of <u>INSECT BAIT (0,3% ai) export</u>						2013	2014	2015	2016	2017	Bolivia	10.000	15.000	15.000	42.400	11.250	Colombia	72.000	108.000	34.000	38.000	92.250	Costa Rica	43.260	31.750	30.000	45.000	30.010	Ecuador	82.000	95.000	72.000	113.010	95.010	El Salvador		10.000	10.000	12.000	12.000	Guatemala	24.000	29.000	32.000	32.000	32.000	Honduras	21.000	35.000	35.000	21.000	21.000	Nicaragua				20.000	10.000	Panama	17.000	30.000	30.000	30.000	45.000	Paraguay	5.000		3.000	3.000	6.000	Peru	12.000			7.000		Suriname		9.000				Uruguay	30	5.000				<b>Total</b>	<b>286.290</b>	<b>367.750</b>	<b>261.000</b>	<b>363.410</b>	<b>354.520</b>
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<p><b>4. Use of sulfluramid</b></p> <p>Please specify the purpose of the use and the years in which the chemicals were used.</p> <p>Please provide the quantities in kg/year.</p>	<p>Use of Sulfluramid for the production of insect baits for control of leaf-cutting ants from <i>Atta</i> spp and <i>Acromyrmex</i> spp.</p> <p>2013- 27.165 kg</p> <p>2014- 28.694 kg</p> <p>2015- 28.069 kg</p> <p>2016- 33.701 kg</p> <p>2017- 33.186 kg</p>																																																																																																
<p><b>5. Local monitoring of releases of PFOS from the use of sulfluramid</b></p>	<p>PFOS and its related compounds are currently used in several countries and in several sectors where there are no technical alternatives available such as in the Photography Industry, Semiconductor Industry, Liquid Crystal Display (LCD)</p>																																																																																																

<p>Please provide information if such local monitoring is conducted.</p>	<p>Industry, Hydraulic Fluid Aviation, Equipment Industry Physicians, Petroleum Industry, Nano-Materials Processing and in others where there are alternative substances or technologies, such as in metal galvanizing, fire fighting foam and production of electrical and electronic parts.</p> <p>For this reason, the limited information available in the literature does not allow us to infer assertively about the origin of PFOS detected in samples of aquatic biota and water on the Brazilian coast( DORNELES et al., 2008; (LÖFSTEDT GILLJAM et al., 2016).</p> <p>Likewise, information on the transformation of sulfluramid into PFOS in soils is scarce and needs to be better understood.</p> <p>For soils from Brazil or even from tropical environments, however, no information is available. Likewise, the occurrence of PFOS associated with agricultural use due to the transformation of sulfluramid, as well as its distribution in different environmental compartments, is scarce.</p> <p>The Stockholm Convention Regional Center (CETESB) is developing a cooperation agreement with the Brazilian Agricultural Research Corporation (Embrapa) to perform biodegradation tests of sulfluramid in PFOS in laboratory. The Study aim to verify the degradation of sulfluramid in representative soils of reforestation areas in order to determine the transformation in PFOS. The survey will be conducted according to international standards (OECD, 2002b), using technical product, as determined in the Ibama Protocol for environmental assessment and registration of pesticides. The selected soil will be incubated in the BOD chamber for a period sufficient to evaluate the formation of metabolites, including PFOS, as well as to determine the degradation kinetics of sulfluramid.</p> <p>There is no study or that made this evaluation concerning about degradation of sulfluramid in PFOS with insect baits containing sulfluramid. Declare that the use of insect bait may represents a release of PFOS in the environment lacks scientific evidence.</p> <p>The degradation studie of sulfluramid was with active ingredient with pH conditions that do not normally occur in nature and never made with the insect bait insecticides containing sulfluramid.</p> <p>It is necessary to obtain conclusive information on the possible formation of PFOS from the insect baits with sulfluramid.</p> <p>ABRAISCA voluntarily decided to seek support from UNESP - Universidade Estadual Paulista "Júlio de Mesquita Filho", through the Professors Doctors Robson Pitelli and Luiz Carlos Forti and Thiago Marcelo Ribeiro Gianeti, Technician specialized in Atomic and Mass Spectrometry, for the realization of a project entitled :</p> <p>"ASSESSMENT OF THE BEHAVIOR AND DEGRADATION OF SULFLURAMID, APPLIED IN THE FORM OF ANT BAIT FOR THE CONTROL OF LEAF-CUTTING ANTS, IN BRAZILIAN SOILS".</p> <p>Such a project is already underway, with the purchase of analytical standards and the development and validation of analytical methods. The project will be carried out in stages, and the first stage includes a study of degradation with the baits in the laboratory, using two types of soils (clayey and sandy) collected in an eucalyptus area. This study will last 182 days. If the results show that there is no degradation of the baits with sulfluramid in PFOS, the project will be closed, and otherwise the project will continue with laboratory and field studies with the biota ( ants, fungus).</p>
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## 2. Canada

<p><b>1. Production of sulfluramid</b></p> <p>Please specify the purpose of the production and the years in which the chemicals were produced.</p> <p>Please provide the quantities in kg/year.</p>	<p>Sulfluramid is not produced in Canada.</p> <p>In Canada, sulfluramid is not registered under the <i>Pest Control Products Act</i> (PCPA). Any pesticide imported into, sold or used in Canada must first be registered under the PCPA.</p>
<p><b>2. Import of sulfluramid</b></p> <p>Please specify the purpose of the import, the countries from which the chemicals were imported and the years in which the chemicals were imported.</p> <p>Please provide the quantities in kg/year.</p>	<p>Sulfluramid is not imported into Canada.</p> <p>In Canada, sulfluramid is not registered under the <i>Pest Control Products Act</i> (PCPA). Any pesticide imported into, sold or used in Canada must first be registered under the PCPA.</p>
<p><b>3. Export of sulfluramid</b></p> <p>Please specify the purpose of the export, countries to which the chemicals were exported and the years in which the chemicals were exported.</p> <p>Please provide the quantities in kg/year.</p>	<p>Sulfluramid is not exported from Canada.</p> <p>In Canada, sulfluramid is not registered under the <i>Pest Control Products Act</i> (PCPA). Any pesticide imported into, sold or used in Canada must first be registered under the PCPA.</p>
<p><b>4. Use of sulfluramid</b></p> <p>Please specify the purpose of the use and the years in which the chemicals were used.</p> <p>Please provide the quantities in kg/year.</p>	<p>Sulfluramid is not used in Canada.</p> <p>In Canada, sulfluramid is not registered under the <i>Pest Control Products Act</i> (PCPA). Any pesticide imported into, sold or used in Canada must first be registered under the PCPA.</p> <p>Canada supports the gathering of information in relation to sulfluramid to determine the global use pattern and to identify and develop suitable alternative chemical and non-chemical approaches. Furthermore, Canada supports discussion regarding the inclusion of sulfluramid as a PFOA related compound due to its potential to degrade to PFOA.</p>
<p><b>5. Local monitoring of releases of PFOS from the use of sulfluramid</b></p> <p>Please provide information if such local monitoring is conducted.</p>	<p>Since there is no use of sulfluramid in Canada, there is no local monitoring of releases from the use of sulfluramid.</p>

### 3. ABRAISCA

<b>1. Production of sulfluramid</b>  Please specify the purpose of the production and the years in which the chemicals were produced.  Please provide the quantities in kg/year.	Production of sulfluramid for the production of insect baits for control of leaf-cutting ants from <i>Atta spp.</i> and <i>Acromyrmex spp.</i> <table><tr><th>Year</th><th>Quantities KG</th></tr><tr><td>2013</td><td>27.162</td></tr><tr><td>2014</td><td>29.652</td></tr><tr><td>2015</td><td>26.901</td></tr><tr><td>2016</td><td>34.145</td></tr><tr><td>2017</td><td>33.449</td></tr></table>	Year	Quantities KG	2013	27.162	2014	29.652	2015	26.901	2016	34.145	2017	33.449																																																																																				
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<b>3. Export of sulfluramid</b>  Please specify the purpose of the export, countries to which the chemicals were exported and the years in which the chemicals were exported.  Please provide the quantities in kg/year.	ABRAISCA do not have export sulfluramid as technical product, but there is export of insect bait for control of leaf-cutting ants containing sulfluramid (0,3%) <table><tr><th>Country</th><th colspan="5">Amount in metric kg of <u>SULFLURAMID</u> export</th></tr><tr><th></th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th></tr><tr><td>Bolivia</td><td>30</td><td>45</td><td>45</td><td>127,20</td><td>33,75</td></tr><tr><td>Colombia</td><td>216</td><td>324</td><td>102</td><td>114</td><td>276,75</td></tr><tr><td>Costa Rica</td><td>129,78</td><td>95,25</td><td>90</td><td>135</td><td>90,03</td></tr><tr><td>Ecuador</td><td>216</td><td>270</td><td>216</td><td>324</td><td>270</td></tr><tr><td>El Salvador</td><td></td><td>30</td><td>30</td><td>36</td><td>36</td></tr><tr><td>Guatemala</td><td>72</td><td>87</td><td>96</td><td>96</td><td>96</td></tr><tr><td>Honduras</td><td>63</td><td>105</td><td>105</td><td>63</td><td>63</td></tr><tr><td>Nicaragua</td><td></td><td></td><td></td><td>60</td><td>30</td></tr><tr><td>Panama</td><td>51</td><td>90</td><td>90</td><td>90</td><td>135</td></tr><tr><td>Paraguay</td><td>15</td><td></td><td>9</td><td>9</td><td>18</td></tr><tr><td>Peru</td><td>36</td><td></td><td></td><td>21</td><td></td></tr><tr><td>Suriname</td><td></td><td>27</td><td></td><td></td><td></td></tr><tr><td>Uruguay</td><td>0,09</td><td></td><td></td><td></td><td></td></tr><tr><td><b>Total</b></td><td><b>828,87</b></td><td><b>1.073,25</b></td><td><b>783</b></td><td><b>1.075,20</b></td><td><b>1.048,53</b></td></tr></table> <p><i>Note 1:</i> the table above is indicating the amount of sulfluramid corresponding to 0,3% of active ingredient.</p>	Country	Amount in metric kg of <u>SULFLURAMID</u> export						2013	2014	2015	2016	2017	Bolivia	30	45	45	127,20	33,75	Colombia	216	324	102	114	276,75	Costa Rica	129,78	95,25	90	135	90,03	Ecuador	216	270	216	324	270	El Salvador		30	30	36	36	Guatemala	72	87	96	96	96	Honduras	63	105	105	63	63	Nicaragua				60	30	Panama	51	90	90	90	135	Paraguay	15		9	9	18	Peru	36			21		Suriname		27				Uruguay	0,09					<b>Total</b>	<b>828,87</b>	<b>1.073,25</b>	<b>783</b>	<b>1.075,20</b>	<b>1.048,53</b>
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**Nota 2:** Abraisca do not export sulfluramid as technical product, but it is export the insect bait (orange pulp + vegetable oil + sulfluramid) as final product.

Country	Amount in metric kg of <b>INSECT BAIT</b> (0,3% ai) export				
	2013	2014	2015	2016	2017
Bolivia	10.000	15.000	15.000	42.400	11.250
Colombia	72.000	108.000	34.000	38.000	92.250
Costa Rica	43.260	31.750	30.000	45.000	30.010
Ecuador	72.000	90.000	72.000	108.000	12.000
El Salvador		10.000	10.000	12.000	90.000
Guatemala	24.000	29.000	32.000	32.000	32.000
Honduras	21.000	35.000	35.000	21.000	21.000
Nicaragua				20.000	10.000
Panama	17.000	30.000	30.000	30.000	45.000
Paraguay	5.000		3.000	3.000	6.000
Peru	12.000			7.000	
Suriname		9.000			
Uruguay	30				
<b>Total</b>	<b>276.290</b>	<b>357.750</b>	<b>261.000</b>	<b>358.400</b>	<b>349.510</b>

**Note 3:** The table above correspond of insect bait as final product (orange pulp + vegetable oil + sulfluramid), indicate in kg.

#### 4. Use of sulfluramid

Please specify the purpose of the use and the years in which the chemicals were used.

Please provide the quantities in kg/year.

Use of sulfluramid for the production of insect baits for control of leaf-cutting ants from *Atta spp* and *Acromyrmex spp*

Year	Quantities KG
2013	26.334
2014	28.579
2015	26.118
2016	33.070
2017	32.401

#### 5. Local monitoring of releases of PFOS from the use of sulfluramid

Please provide information if such local monitoring is conducted.

PFOS and PFOS related compounds have been in commercial use for approximately 50 years (Lehmle, 2005) in a wide range of applications in three broad categories - surface treatments, paper coatings and performance chemicals (OECD, 2002). Surface treatment applications provide soil, oil, and water resistance to clothing, carpets and furniture. PFOS-related chemicals are also used in consumer treatments for clothing, upholstery, carpet, and car interiors. Paper coatings include those for food packaging (containers, bags, and wraps). Other applications of PFOS chemicals include fire fighting foams, mining and oil well surfactants, acid mist suppressants for metal plating and electronic etching baths, photolithography, electronic chemicals, hydraulic fluid additives, alkaline cleaners, floor polishes, photographic film, denture cleaners, shampoos, chemical

	<p>intermediates, coating additives and carpet spot cleaners, and insecticides (OECD, 2002).</p> <p>There are numerous studies reporting the occurrence of PFCs in the environment, wildlife and humans (see above), but knowledge and understanding of the routes by which these contaminants enter the environment, and their fate and transport once in the environment, is still very limited. The process(es) by which breakdown products of PFCs, used as surfactants and coatings in consumer products, end up in human blood and wildlife in remote polar regions is a puzzle that is only now being slowly unravelled.</p> <p>Direct emission or accidental escape of PFCs to the environment can occur during their manufacture and application to consumer articles (Prevedouros et al., 2006, Stock et al., 2004). Research has also suggested that residual, unwanted PFCs left over from the manufacture of fluorinated surfactants and polymers, remain in their industrial and consumer applications and escape during use to be broken down in the environment to compounds such as PFOS and PFOA (i.e. the leftover PFCs act as precursor compounds) (Dinglasan-Panlilio &amp; Mabury, 2006). An important source of PFCs into the environment is thought to be the discharge of wastewater from sewage treatment works, as the cleaning and care of surface-treated products (from clothing to carpets) by consumers and use in industrial processes are believed to release these compounds to municipal wastewater treatment systems (Boulanger, 2005a, Higgins et al., 2005). PFCs can then enter the aquatic environment and find their way into aquatic food webs. Discarded consumer articles containing PFCs may also contribute PFCs to the environment by leaching from landfills (Boulanger, 2005a, Stock et al., 2004). Direct use of firefighting foams might also contribute PFCs to the environment (ENDS, 2006b, Prevedouros et al., 2006, Simcik &amp; Dorweiler, 2005). Due to the presence of PFCs in sewage sludge, application of sludge to agricultural land could be a potential source of PFCs to the terrestrial environment i.e. soil (Higgins et al., 2005, Prevedouros et al., 2006).</p> <p>Precipitation of PFCs in rainwater may also contribute these compounds to soils, and it is thought that soil may be a very important environmental sink for PFCs (Renner et al, 2006b).</p> <p>The use of consumer articles containing PFCs have been suggested as potential routes (Kannan et al., 2004., Prevedouros et al., 2006), although more work is needed in this area. Kannan et al. (2004) state that “prolonged use of perfluorochemicals for a wide variety of applications, such as paper and packing products, residential and mill-applied carpet spraying, stain resistant textiles, and cleaners, may be a major source of human exposure to these compounds” and suggest the variation in the levels of PFOS in human blood seen in different countries is due to different patterns of use of consumer articles containing PFCs. For example, the use of carpets and fast food packaging is widespread in developed nations such as the United States, whereas it is minimal in India.</p> <p>For this reason, does not allow us to infer assertively about the origin of PFOS detected in samples of aquatic biota and water on the Brazilian coast (DORNELES et al., 2008; (LÖFSTEDT GILLJAM et al., 2016).</p> <p>Declare that the use of insect bait with sulfluramid may represent a release of PFOS in the environment lacks scientific evidence.</p> <p>For soils from Brazil and tropical environments no information is available. Information on the transformation of sulfluramid into PFOS in soils is scarce and needs to be better understood.</p> <p>There is no study about degradation of sulfluramid in PFOS with insect baits containing sulfluramid. The paper presented at the Stockholm Convention was</p>
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	<p>made in laboratory with active ingredient with pH conditions that do not normally occur in nature.</p> <p>For the expose above it is necessary to obtain conclusive information on the possible formation of PFOS from the insect baits with sulfluramid.</p> <p>ABRAISCA voluntarily decided to make a project study entitle “<i>Assessment of behaviour and degradation of sulfluramid, applied in the form of ant bait for the control of leaf-cutting ants in brazilian soils</i>”. This study is being conduct with Universidade Paulista Julio Mesquista – UNESP, by the Prof. Dr. Robinson Pitelli and Prof. Dr. Luiz Carlos Forti and technician specialized in atomic and mass spectrometric Thiago Marcelo Ribeiro Gianeti.</p> <p>The proposal of this study is evaluate with the insect bait with sulfluramid may degrade or not into PFOS. The project will be carried out in stages, and the first stage includes a study of degradation with the baits in the laboratory, using two types of soils (clayey and sandy) collected in an eucalyptus area. This study will last 182 days. If the results show that there is no degradation of the baits with sulfluramid in PFOS, the project will be closed, and otherwise the project will continue with laboratory and field studies with the biota (ants, fungus).</p>
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#### 4. PAN

<p>Subject: PFOS SULFURAMIDA – Answers by MAPA (Brazilian Ministry of Agriculture)</p> <p>Text: Dear Ms. Zuleica Nycz,</p> <p>1) Detailed information on the production of sulfuramide in Brazil since 2009: which companies are producing and which are the annual quantities of domestic production;</p> <p>A.: We only have data referring to 2013. There are five companies that produce SULFLURAMIDA-based formicidal baits for use in agriculture in Brazil: Adama do Brasil S / A; Atta Kill Indústria e Comércio de Defensivos Agrícolas Ltda; Bio Soja Industrias Químicas e Biológicas Ltda; Dinagro Agropecuária Ltda and Unibrás Agro Química Ltda.</p> <p>2013- 28,684 kg; 2014- 30,637 kg; 2015- 29,542 kg; 2016- 35,511 kg; 2017- 35,090 kg</p> <p>2) Detailed information on the trade of sulfuramide in Brazil: nationally marketed quantities and information on specific uses of sulphuramide (companies, regions where it is marketed and annual quantities);</p> <p>A.: We only have data referring to 2013. There are five companies that sell SULFLURAMIDA-based formicidal baits for use in agriculture in all five Brazilian administrative regions: Adama do Brasil S / A; Atta Kill Indústria e Comércio de Defensivos Agrícolas Ltda; Bio Soja Industrias Químicas e Biológicas Ltda; Dinagro Agropecuária Ltda and Unibrás Agro Química Ltda 2013- 27,165 kg 2014- 28,694 kg 2015- 28,069 kg 2016- 33,701 kg 2017- 33,186 kg</p> <p>3) Detailed information on the sales and uses of sulfuramide for purposes other than the combat of ants cutters in Brazil;</p> <p>A.: The MAP does not have this information, we suggest contacting the Ministry of the Environment for further clarification on the consultation. MAPA only controls products for use in agriculture.</p> <p>4) Detailed information since 2009 of imports of sulfuramide, annual quantities, importers and exporters;</p> <p>A.: Brazil does not import SULFLURAMIDA. All SULFLURAMIDA used in Brazil is produced nationally.</p> <p>5) Information on the monitoring of PFOS from the use of sulfuramide, and on environmental contamination;</p> <p>A.: The MAP does not have this information, we suggest contacting the Ministry of the Environment for further clarification on the consultation.</p>	
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6) Information on Research and Development of safe alternatives to PFOS, its salts and PFOSF as stipulated in paragraph 4 (c) of part III of Annex B of the Convention.

A.: Brazil submitted to the Secretariat of the Stockholm Convention a Peer Review Study carried out under the coordination of MAPA, which integrates the technical documents of the Stockholm Convention for PFOS and PFOSF chemicals, among which we highlight the following: ( UNEP / POPS / POPRC.12 / INF / 15 / Rev.1). This study was also published in an international journal and is available for consultation: BRITTO, J. S .; FORTI, L. C .; OLIVEIRA, M. A .; ZANETTI, R .; WILCKEN, C. F .; ZANUNCIO, J. C .; LOECK, A.E .; CALDATO, N .; NAGAMOTO, N. S .; LEMES, PG and CAMARGO, RS, 2016. Use of alternatives to PFOS, its salts and PFOSF for the control of leaf-cutting ants *Atta* and *Acromyrmex*, International Journal of Research in Environmental Studies (2016) 3 (2):

7) Which countries have been importing sulfuramide from Brazil since 2009;

A.: Argentina, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, Peru, Suriname and Uruguay

8) Which companies in Brazil are exporting sulfuramide and which are the annual quantities since 2009;

A.: There are only two companies that export SULFLURAMIDA-based products that are: Atta kill Industry and Commerce of Defensivos Agrícolas Ltda and Adama Brasil S / A. As previously reported we have data for 2013. 2013: 1518,87 kg 2014: 1943,25 kg 2015: 1473 kg 2016: 2110,23 kg 2017: 1903,56 kg

9) Detailed information on sales and sales uses of sulfuramide, including uses other than for the control of leaf-cutting ants in countries to which Brazil exports the product;

A.: MAPA does not have this information.

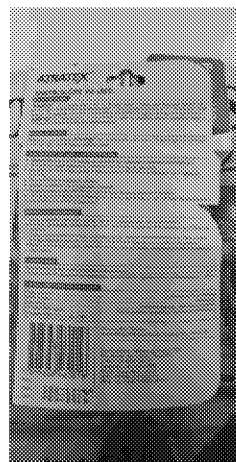
10) Information on whether importing countries (since 2009) are Parties to the EC and whether these countries have registration for acceptable use with the EC Secretariat?

A.: MAPA does not have this information.

11) Information on what efforts Brazil has been making to ensure that sulfuramide is only used for acceptable use in importing countries, and whether such importing countries have been required to notify the EC Secretariat of imports and intended uses.

A.: MAPA does not have this information.

Att, ANDRÉ FELIPE C. P. DA SILVA Director of DFIA / SDA



## 1. Sulfluramid use

Sulfluramid production and environmental dispersal has been increasing since PFOS was listed under the Stockholm Convention with sulfluramid as an acceptable use for two species of leaf-cutting ants, *Atta* spp. and

Acromyrmex spp. A recent paper by the government of Brazil,<sup>1</sup> describes the control of leaf-cutting ants as “essential for Brazilian agribusiness”, referring to these two species of ants as “the main pest of forest plantations, agriculture and livestock” – mentioning in particular eucalyptus and pine plantations, grass for livestock, sugar cane, grains, and fruit, but provides no argument for the control of leaf-cutting ants in urban houses. Information provided by Brazil to the POPRC<sup>2</sup> for the addendum to its Risk Management Evaluation also refers only to economic losses due to the impacts of leaf-cutting ants on trees, sugar cane, soybean and maize, whilst the original Risk Management Evaluation<sup>3</sup> referred only to Brazilian agriculture. No argument has been made for the use of sulfluramid in urban areas or for use on other species of ants or insects, and yet it continues in Brazil in contravention of the Stockholm Convention. Use appears to be very poorly controlled in Brazil, both in terms of exports to countries that have not registered acceptable uses under the Stockholm Convention, and in terms of uses that are not regarded by the Brazilian government as essential or are not listed as acceptable purposes under the Stockholm Convention.

### **1.1 According to the review by Gilljam et al (2016):**

- Sulfluramid was introduced to Brazil in 1993.
- From 2004-2006, production in Brazil was estimated as 30 tonnes per year, with imports of < 1 tonne/yr from China.
- Production and use of sulfluramid in Brazil jumped dramatically between 2009 and 2010: production increased from 22.67 tonnes/yr in 2008, to 51.31 tonnes/yr in 2010, and it continued to escalate at least until 2013.
- By 2013, Brazilian sulfluramid manufacturing had increased to 59.66 tonnes per year, with over 1 tonne imported, and internal use of 57.98 tonnes.
- The number of manufacturers increased from 5 nationally-owned companies in 2007 to 7 companies in 2012.
- During this time <1.3 tonnes per year were imported, while exports increased from ~0.3 tonnes in 2004/yr to 2 tonnes/yr in 2014.
- From 2004 to 2015, most exported sulfluramid went to Argentina (7.2 tonnes), Colombia (2.07 tonnes), Costa Rica (1.13 tonnes), Ecuador (2.16 tonnes), and Venezuela (2.4 tonnes).
- Other countries importing sulfluramid from Brazil in 2014-2015 were Bolivia, Guatemala, Honduras, Panama, Paraguay, Suriname, Uruguay, and USA.
- Between 2004 and 2013, sales of sulfluramid in Brazil increased from ~23 to 58 tonnes/yr, during which time nearly 87% of cumulative sales were in 5 states: Minas Gerais (33.6 tonnes), Mato Grosso do Sul (25.6 tonnes), São Paulo (22 tonnes), Bahia (11.7 tonnes), and Espírito Santo (8 tonnes).
- 2 tonnes of sulfluramid were used in Bahia in 2013. These quantities are likely to be underestimated because of data missing for certain years.
- Sulfluramid is manufactured in a variety of formulations containing 0.01–1% w/w granular baits and 93–98% w/w (technical product).

### **1.2 According to information provided by MAPA (Brazilian Ministry of**

Agriculture) in February 2018, and relevant from 2013:5

- Since 2013, 5 companies are producing sulfluramid baits for use in agriculture: Adama do Brasil S / A; Atta Kill Indústria e Comércio de Defensivos Agrícolas Ltda; Bio Soja Industrias Químicas e Biológicas Ltda; Dinagro Agropecuária Ltda and Unibrás Agro Química Ltda.

- The following quantities were produced:

2013 – 28.68 tonnes

2014 – 30.64 tonnes

2015 – 29.54 tonnes

2016 – 35.51 tonnes

2017 – 35.01 tonnes

- Information on sales and use for other than leaf-cutting ants was not available from MAPA.
- Brazil does not import sulfluramid.
- Since 2009, Brazil has exported sulfluramid to Argentina, Bolivia, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, Peru, Suriname and Uruguay.
- Two companies export sulfluramid: Atta kill Industry and Commerce of Defensivos Agrícolas Ltda, and Adama Brasil S / A, in the following quantities:

2013: 1518,87 kg

2014: 1943,25 kg

2015: 1473 kg

2016: 2110,23 kg

2017: 1903,56 kg

#### **1.4 Gilljam et al 2016b6**

This follow-up paper to acknowledges the differences in estimates of sulfluramid production between Gilljam et al 2016 and the Government of Brazil, specifically in terms of the information in their National Implementation Plan, 2015; but this is also relevant to the above information from MAPA. There appears to be uncertainty as to the actual amount of sulfluramid produced because of a lack of clarity about the amount of imported PFOS and how much of that is converted to sulfluramid.

#### **1.5 Non-complying domestic use of sulfluramid**

Gilljam et al (2016b) also reported 69 additional sulfluramid products produced by 31 companies for household use, and that agricultural companies also have sulfluramid products registered for domestic use – including pastes to control termites, pastes to control cockroaches, and paste and granulated baits to control household ants. All these uses do not comply with the Stockholm Convention. According to Gilljam et al (2016b), as of January 8th, 2015, the Brazilian Health Surveillance Agency (Anvisa) set a period of 1 year for companies to sell their stocks and remove products from the Brazilian market (Anvisa Resolution, RE No. 41). However, sulfluramid is still widely available, including being sold over internet, to the general public at cheap prices, for uses other than those of economic importance involving leaf-cutting ants, including for cockroaches and household ants that are called sweet ants or urban ants. These products are for sale to the general public without any warnings about danger to the environment or persistence. Technical information provided by the Paraná state government states that DINAGRO-S (0.3% sulfluramid) is for three Atta spp. only (Atta capiguara or saúva parda, Atta sexdens rubropilosa or saúva limão, Atta laevigata or saúva cabeça de vidro), and that the product is classified as dangerous for environment, highly persistent and has high bioaccumulation.<sup>7</sup> Yet a manufacturer UNIBRAS AGRO QUIMICA states that its product ATTA MEX-S is of low toxicity for humans and the environment.

The following products were still advertised for purchase over Internet and/or available in stores in Brazil on February 14th 2018:

- Atratex – contains sulfluramid (0.3%); advertised for sweet ants. Product was purchased from a garden and pet store in Curitiba, the capital city of the state of Paraná, on February 14th 2018. The reverse side of the label recommends it for domestic ants; states how to used (Distribute the content of ATRATEX in various points using the dispenser. Apply in dry places most frequented by the ants); manufactured by SINGRA QUIMICA LTDA, Piracicaba, São Paulo State; manufacturing date: February 2017 (see attached photos).
- Formikell Gel: contains sulfluramid (0.1%); all types of ants including sweet ants in houses and gardens.
- Formisca: contains sulfluramid; for use against ants in homes and gardens.
- Formibel: contains sulfluramid (0.2%); sold in supermarkets for use against sugar ants.
- Rainha Verde S: contain sulfluramid (0.01%); for amateur use in gardens and near houses.

- Blatacel S: contains sulfluramid (1%); for use on cockroaches (*Blattella germanica* and *Periplaneta americana*); registered with ANVISA (No Registro no M.S./ANVISA: 3.1704.0048.001-1).
- Formicida 7 Belo Gel: according to the website this product contains sulfluramid (0.2%); for ants in homes (sweet ants);<sup>15</sup> however on another part of the website it says the active is indoxacarb.
- Ferra Baratas: contains sulfluramid; for cockroaches.
- FORISK GEL: contains sulfluramid; for “urban ants”; also sold in a pet shop for home and garden use.<sup>18</sup>
- BARAMID GEL: contains sulfluramid; also sold in a pet shop, for cockroaches.

## 2. Sulfluramid in the environment

### 2.1 According to the review by Gilljam et al (2016):

- All catchments from the 5 states Minas Gerais, Mato Grosso do Sul, São Paulo, Bahia, and Espírito Santo where the majority of sulfluramid is used, drain into the Atlantic Ocean.
- PFASs were detected in all samples of surface water taken in Bahia, at concentrations ranging from 287 to 4879 pg/L ΣPFASs. Whilst sulfluramid itself was not detected, PFOS was detected in all samples (63-1061pg/L). FOSA was found in four out of seven samples and was present in the highest levels ( $\leq 14-3362$  pg/L).
- The high FOSA/PFOS ratio observed (up to 14:1) is unprecedented in the scientific literature; and is suggestive of degradation of sulfluramid. The ΣPFAS profile of some samples, those that did not contain elevated FOSA are indicative of an industrial source.
- Depending on the extent of conversion of sulfluramid to PFOS, cumulative Brazilian sulfluramid production and import from 2004 to 2015 may contribute between 167 and 487 tonnes of PFOS/FOSA to the environment.
- Modelling, using the Level III Fugacity-based Multimedia Environmental Model (Version 2.80), which simulates the steady state distribution of a chemical in a closed environment, predicts that the only significant removal process of sulfluramid is predicted to be transformation in soil to form FOSA, FOSAA, and PFOS, with PFOS readily transported in the soil pore water and to enter surface waters. As the application of sulfluramid is to the soil to control leaf-cutter ants, emissions were assumed to occur exclusively to soil. While the emission rate is often arbitrary in evaluative modelling, the authors chose a “realistic emission rate” of 0.35 tonnes/yr or 0.04 kg/h.
- Cumulative import and production of sulfluramid in Brazil from 2004 to 2015 are estimated to equate to approximately 147.3 tonnes of anionic FOSA and 19.5 tonnes of anionic PFOS (166.8 tonnes total), but this is thought to be an underestimation. If complete conversion of sulfluramid to PFOS is assumed, then Brazilian sulfluramid could contribute up to 487 tonnes of PFOS in the environment.

### 2.2 Uptake by crops

An experiment carried out in a soil/carrot mesocosm over 81 days, to assess uptake, leaching, and biodegradation of sulfluramid (N-ethyl perfluorooctane sulfonamide (EtFOSA) and its transformation products, demonstrated that the use of sulfluramid baits can lead to residues of PFOS in crops, and in the surrounding environment, in considerably higher yields than previously thought. The more hydrophilic transformation products, such as PFOS, were found mainly in the leaves, and the more hydrophobic products (e.g. FOSA, FOSAA and EtFOSA) in the peel and core of the carrots. A sulfluramid technical standard yielded 34% PFOS, while the commercial bait formulation Grão Forte bait formulation containing 0.0024 % EtFOSA yielded up to 277 %, the higher yield thought to be associated with one or more unidentified PFOS-precursors in the commercial bait. A longer exposure time is expected to produce even higher yields of PFOS.